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A SYMPOSIUM ON ANTERIOR CHOROIDAL ARTERY OCCLUSION AND CHEMOPALLIDECTOMY IN THE TREATMENT OF PARKINSON'S DISEASE

INTRODUCTION

During the past few years, I have been privileged to be invited to take part in each annual symposium of the American Geriatrics Society. On each occasion I have been asked to bring up to date the results of our investigations into the neurosurgical therapy of parkinsonism. This has afforded me an annual opportunity not only to acquaint many of my colleagues personally with the newer techniques developed on our service and to summarize our results for them, but also to present many patients who had been operated upon for parkinsonism so that the results could be evaluated personally by those attending the annual symposium.

It has been my unswerving contention during the course of this investigation that all academic considerations regarding the feasibility of surgical treatment of parkinsonism, as well as potentialities of any particular technique, must ultimately be judged and evaluated by the criterion of factual results. Thus, it has been my aim during these annual presentations to the American Geriatrics Society, as well as in any other publication or presentation, to report in a documented fashion the clinical observations and results of our studies. I have tried at all times to make it patently clear that the crux of the matter in this investigation, as in all other scientific investigations, must be the facts. Theories and hypotheses are admirable and necessary; deductions based on previous experience are often brillant; but *in judging whether or not parkinsonism can be treated neurosurgically and in judging the results of any particular surgical technique, cold, hard facts are the scientist's best friend.*

At the invitation of the American Geriatrics Society, it is the purpose of my colleagues and myself to present to you the data which have been accumulated during four years of investigation into the surgical therapy of parkinsonism. In addition to demonstrating and presenting these factual results of surgical therapy of tremor and rigidity, we should like to report some data which have been gathered during the course of this investigation on other aspects of parkinsonism. Thus, this presentation will include factors which we feel have not been stressed enough in the past regarding the clinical course of parkinsonism. Particular emphasis in this regard will be placed on the results of our psychologic investigations in this disease. The preoperative techniques for selection of patients for surgery on our service will be summarized. The most recent technical developments which we feel are worthy of note will be mentioned, and our further experience in the postoperative care of such patients will be tabulated. However, as heretofore, emphasis will be placed on presenting an up-to-date, factual account of the clinical results which have been achieved up to the present time.

IRVING S. COOPER, M.D.

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The contributors to this Symposium wish to dedicate this volume with respect and admiration to their friend and advisor,

DR. HOWARD A. RUSK

CLINICAL RESULTS AND FOLLOW-UP STUDIES IN A PERSONAL SERIES OF 300 OPERATIONS FOR PARKINSONISM*

IRVING S. COOPER, M.D.

Although one may justifiably evaluate medical and surgical procedures by the contribution which they may make to the basic understanding of pathologic and physiologic processes, the ultimate criterion by which a procedure devised for the alleviation of disease must justify itself is by the degree to which it can cure the infirm and make sick people well. Thus, although it has been our purpose during the investigative phase of the development of the techniques of anterior choroidal artery occlusion and chemopallidectomy to seek basic information regarding the mechanism of tremor and rigidity, our primary goal has been to develop a method of therapy for patients with parkinsonism. It is the purpose of this report to summarize the results which have been achieved in that direction.

In surveying the results of the 300 cases in our personal series at this time it seems appropriate to try to answer the following questions: 1) Can tremor and rigidity, the most tedious and disabling symptoms of parkinsonism, be treated by neurosurgical intervention? If so, to what extent are the particular techniques which are the subject of this report successful in so doing? 2) What are the complications which have ensued as a direct result of surgical intervention in these 300 cases? 3) How might one rate the status of the patients who underwent surgery in this series with that of a similar group of patients who were not operated upon? 4) How do these techniques compare with other methods of therapy for parkinsonism? 5) How might one summarize the status of these surgical techniques at the present time?

I shall set down the objective data which I have been able to accumulate as regards the results which have been obtained in this series of cases. By so doing, I shall try to answer directly the foregoing questions or to supply enough information to enable the reader to form his own conclusions. Elsewhere in this journal appear disinterested, objective appraisals of the same series of cases by evaluators who were not directly concerned with the surgical phase of the investigation nor the development of the surgical techniques.

RESULTS OF ANTERIOR CHOROIDAL ARTERY OCCLUSION

The total series of cases of anterior choroidal artery occlusion numbers 55. The results in these 55 cases have already been reported in considerable detail. Therefore, they need be only briefly summarized here.

Resting parkinsonian tremor was virtually abolished in the extremities contralateral to the occluded anterior choroidal artery in 65 per cent of our cases. This relief of tremor was accomplished without any compromise of motor function of the extremities and, moreover, it has persisted up to the present time. Rigidity

* Forty of these patients, all of whom responded favorably to the operation, were shown before the Graduate Symposium on Geriatric Medicine, New York City, November 19, 1956.

has been markedly alleviated or abolished in 75 per cent of the cases of successful occlusion of the anterior choroidal artery. In several of these patients in whom rigidity had been so marked as to render them bedridden prior to operation, complete absence of rigidity and cogwheelism was noted postoperatively and during the follow-up periods by many independent evaluators.

Concomitant with the relief of rigidity in many cases, there was a marked alleviation of incapacitation and helplessness. Several patients who had been completely bedridden for several years prior to surgery were restored to a state of complete independence and some progressed far enough to become gainfully employed after many years of helplessness. More specific information regarding relief of tremor, rigidity, abnormal gait, disability, deformity, masked facies, painful cramps and other stigmata of the disease is already recorded in previous publications, and I need not elaborate further on this aspect of the problem. It is worthy of note, however, that thus far in our experience there has been no recurrence of the alleviated signs and symptoms in any case that has been reported as a successful result of anterior choroidal artery occlusion in this series. Thus, it appears that if symptoms are abolished by the operation of anterior choroidal artery occlusion and remain abolished for approximately four months, it is likely that the relief of symptoms will be enduring.

One might put the preceding statement to the critical test of factual documentation by inquiring specifically about the present status of cases which were reported in detail two or more years ago. Thus, for example, one might investigate the current status of the 3 patients operated upon early in this series, who were chosen as representative examples of good results to be reported in the communication published in *Surgery, Gynecology & Obstetrics* in 1954. Each of these patients has been followed personally and has been checked individually by the others who have served to examine the patients in this series. In the following brief case reports, the results in these 3 representative patients have been brought up to date and their progress and freedom from regression of symptoms thereby documented.

Case reports

W.T. A 36-year-old white male had bilateral tremor and rigidity of postencephalitic parkinsonism of eighteen years' duration. He had become completely incapacitated and had been hospitalized for four years in a state hospital. During this time he was bedridden and required nursing care for all activities of daily living. In February 1953, the left anterior choroidal artery was occluded surgically, and the following month the same procedure was carried out on the right anterior choroidal artery. Since that time the patient has been ambulatory and independent in all activities of daily living. Tremor and rigidity have been virtually abolished bilaterally and the results have endured up to the present time. This previously bedridden, incapacitated patient was subsequently discharged from the hospital and is presently living alone and managing his daily life and activities of daily living unassisted. This provides a follow-up of almost four years in a case of bilateral, surgical occlusion of the anterior choroidal artery. There has been no recurrence to date.

A.T. A 59-year-old male who had postencephalitic parkinsonism of twenty-five years' duration had been incapacitated and unable to care for himself for seventeen years. He had become bedridden and required constant nursing care. He had to be carried from place to place in his house and could not walk unassisted. His incapacitation was chiefly due to marked rigidity of all four extremities. Tremor was moderate in all four extremities.

In July 1953, the right anterior choroidal was occluded surgically. Since that time the patient has been entirely free of tremor and rigidity of the left extremities. These extremities have been useful and the freedom from tremor and rigidity was accomplished without any sacrifice of motor function. Although relieved only on one side by this operation, the patient became ambulatory and completely independent in all activities of daily living. He has been able to do the housework at home, as well as provide for his own needs. He goes about New York using public transportation unaccompanied by any member of his family. Complete freedom of tremor and rigidity following anterior choroidal artery occlusion has persisted in this case for three and a half years without any evidence of recurrence.

W.D. In a 41-year-old white male postencephalitic parkinsonism had developed at the age of 16. The patient had been totally incapacitated for twenty-five years. In addition to a pronounced degree of masked facies, diminution of voice, difficulty in swallowing, propulsion and retropulsion, and bilateral tremor and rigidity, there was a marked dystonic deformity of the left upper extremity. This patient had required nursing care throughout twenty-five years of incapacitation.

The right anterior choroidal artery was occluded in September 1953. This operation resulted in complete abolition of tremor and rigidity of the left extremities, and in addition completely reversed the dystonic deformity of the left hand and wrist. There was improvement in the masked facies and in ability to speak. This patient has now been followed more than three years since the operation and all gains have persisted. One year ago, a left chemopallidectomy was performed, which resulted in alleviation of tremor and rigidity of the right extremities. This patient has had enduring results for more three years from a right anterior choroidal artery occlusion and for more than one year from a left chemopallidectomy.

Thus, these 3 patients who were reported early in the series as representative cases of good results of anterior choroidal artery occlusion have been followed for four, three and a half, and three years respectively. The good results originally reported have endured.

The risk of mortality from anterior choroidal artery occlusion is 10 per cent. The risk of enduring hemiplegia as a result of this operation is 8 per cent. The operation must be limited to patients under the age of 55 and is best suited for far-advanced cases with great disability and incapacitation.

I have not performed anterior choroidal artery occlusion on my service during the past year for the following reasons: 1) This interval has afforded a good opportunity to evaluate the follow-up results in this series of cases. 2) Our service during this interim has devoted itself to the perfection and appraisal of the technique of chemopallidectomy, and to a comparison of the results of this operation with those of anterior choroidal artery occlusion. The findings reported here enable one to evaluate the efficacy as well as the hazards of each procedure.

Many others have confirmed the value of anterior choroidal artery occlusion and its potentialities of producing a remarkable degree of relief of tremor, rigidity, deformity and incapacitation.

In surveying this series of 55 patients who underwent anterior choroidal artery occlusion, all of whom were operated on by one surgeon and meticulously followed and appraised by many objective observers, one is afforded an excellent vantage point from which to make a concise appraisal of the successes, failures, complications and sequelae over the past four years, and to compare these patients with other groups of patients who were treated either surgically or non-surgically as

controls. Having supplied the data from our own study, I shall leave these latter evaluations to the reader.

It is obvious that although we speak of lesions in the globus pallidus or ansa lenticularis or subpallidal region, we really are still in a state of knowledge wherein these designations probably constitute a rather crude appraisal of the precise area affected in the relief of tremor and rigidity. Eventually we hope to be afforded the opportunity to study in great detail the cerebri of some of the patients who have been successfully relieved of tremor, rigidity, and deformity by anterior choroidal artery occlusion and have lived several years after such an operation—having been followed meticulously during the interim. Then we shall be in a position to gain considerable insight into the pathologic physiology of these manifestations and, as well, to apply the techniques which can relieve them.

Having had the advantage of surveying the lasting relief of tremor, rigidity, deformity and incapacitation (up to four years, thus far) that has been produced by anterior choroidal artery occlusion, we conclude that this operation merits employment in incapacitated parkinsonians under the age of 55. It is, however, more hazardous than chemopallidectomy. For that reason, on a neurosurgical service which has perfected the latter technique, anterior choroidal artery occlusion should be reserved for chair-ridden or bedridden patients, who have been greatly incapacitated for a long time. Such patients can well afford the risk of an operation that holds the possibility of restoring them to a status of reasonable well being and independence.

RESULTS OF CHEMOPALLIDECTOMY

This report covers the results of 245 consecutive chemopallidectomies performed on our service. These operations include every procedure that has been performed since the first experimental injection of the globus pallidus that was carried out on our service. Thus, the results reflect the entire spectrum of our experience from the early application and development of this technique to the later period during which the technique became perfected, benefiting a higher percentage of cases, and with much less operative hazard and risk.

All of the operations reported were performed by the author or, during the past year, by the residents on the service under the supervision of the author. Thus, for practical purposes, this series of patients has the advantage of having received a rather uniform level of operative intervention throughout, except for the fact that the last 100 patients obviously benefited to some degree by the technical and clinical experience accumulated during the earlier part of the investigation.

Immediate postoperative results

Almost from the inception of this investigation it was found possible to localize a cannula accurately into the globus pallidus by hand or by one of the other simple techniques outlined previously, so that injection of procaine or alcohol through this cannula will produce immediate relief of tremor and rigidity of

the contralateral extremities in 85 per cent of cases. This is particularly true if one patiently studies the roentgenographic films made during operation and meticulously replaces the cannula a second or third time if the first attempt fails to produce the desired results.

Thus, the technique of chemopallidectomy can induce immediate or prompt relief of contralateral tremor and rigidity in 85 per cent of cases. The problem that has proved to be more exacting than the localization of the cannula and production of an immediate beneficial postoperative result, has been the development of a technique which would enable such immediate relief to endure.

Intermediate postoperative results (one to eight weeks)

During the early phases of the development of chemopallidectomy it became apparent that in most instances a single injection of absolute alcohol into the globus would not suffice to produce an enduring and complete alleviation of both tremor and rigidity. This pertains particularly to tremor, which has been consistently more difficult to relieve completely and permanently than has rigidity.

It is our impression, that as one injects absolute alcohol into the globus, one achieves an immediate zone of neurolysis which is surrounded by a secondary zone of tissue compression and a tertiary zone of edema. Thus, the immediate alleviation of contralateral tremor and rigidity is due not only to the neurolytic effect of the alcohol but also to some degree to the compressional, concussional, or edema effect in adjacent neurons and nerve fibers.

This conclusion led us to the technique of permitting the cannula to remain in the brain for seven to ten days following operation. This allows one to await the regression of the effect of edema and compression of neurons in the globus, so that by the third, fourth or fifth day after operation that part of the operative result which is due to secondary effects has disappeared. Thus, if the neurolytic effect of the alcohol itself is not sufficient to produce a lasting result, then some degree of recurrence of the symptoms becomes evident. For this reason, we have developed a technique of a second, and sometimes a third injection through the indwelling cannula during the first seven to ten days after operation and prior to permanent removal of the cannula.

During the first week after operation, approximately 50 per cent of patients will have some degree of recurrence of the tremor and rigidity in the extremities. By means of the re-injection technique, most of these intermediate recurrences can be completely alleviated, so that by the time the cannula is removed from the brain on the seventh or tenth day after surgery, approximately 80 per cent of patients are still relieved of contralateral tremor and rigidity.

With the present technique it is possible at the time of surgery to relieve tremor and rigidity contralateral to the side of operation in 85 per cent of patients. However, by the end of the postoperative period of seven to ten days, when the brain cannula is removed, the wound has healed and the patient is up and about, this figure has been reduced to 80 per cent. We have found, therefore, that during this intermediate postoperative period the incidence of recurrence is 5 per cent.

During the next seven weeks there is a further increase in the incidence of recurrence of symptoms. In an additional 5 per cent of the patients in our series there was a significant degree of recurrence by the eighth postoperative week. Frequently some evidence of recurrence in this additional 5 per cent of patients will be noted prior to dismissal from the hospital or immediately thereafter. At any rate, by the time the eighth postoperative week has been reached, the proportion of patients who have maintained excellent relief of contralateral tremor and rigidity has been reduced to 75 per cent.

At this point the incidence of recurrence seems to abate. That is, those patients who are relieved at the time of surgery and whose relief is augmented by re-injection during the first ten postoperative days and maintained up to the eighth postoperative week, are almost assured of lasting relief of tremor and rigidity as a result of chemopallidectomy.

The crucial period as regards the possibility of a return of tremor and rigidity following chemopallidectomy, in our experience thus far, is during the first eight postoperative weeks. During the first period of this study, not infrequently we would re-operate on patients in whom there was a recurrence during the first eight weeks. In fact, some of the most spectacular results in the series occurred among patients who underwent a second operation during this time for some degree of recurrence. However, during the latter period of this study, we instituted the use of a two-catheter technique to insure a larger and more permanent lesion, with the consequence that there was much less need for re-operation.

Long-term results

Seventy per cent of this entire series of patients undergoing chemopallidectomy have had lasting relief (three to twenty-four months) of tremor and rigidity contralateral to the side of operation, without impairment of motor or sensory function. This figure is based, not only on the results of personal examination of these patients by the author, but also on the documented opinions of the patient, relatives of the patient, hospital technicians, and the follow-up team of neurologists, physiatrists, psychologists and internists who collaborated in the study.

Although these various disciplines were represented in the objective evaluation of each patient, the results to which I refer in this particular report are limited specifically to the surgical relief of tremor and rigidity. Moreover, such relief had to be clearly evident on an objective basis. Several patients who reported great subjective relief, but in whom cogwheelism and rigidity persisted, were not listed as having a satisfactory result, even though they insisted that they felt better following operation. Moreover, the techniques in question in this report had as their principal purpose the relief of involuntary movements and rigidity. Therefore, in my evaluation I have limited the analysis to those patients relieved of rigidity and involuntary movements who did not suffer any untoward sequela of operation. This particular report does not deal with ancillary results of operation such as psychologic benefit, return of sexual capacity, or improvement in alimentation.

One frequently observed salutary result, probably related to relief of rigidity,

was the relief of painful cramps in the affected extremities. In cases in which such painful cramps existed, there was complete relief following chemopallidectomy in practically every case. Thus, we consider painful cramps accompanying rigidity one of the prime indications for operation.

COMPLICATIONS OF CHEMOPALLIDECTOMY

Mortality rate

There were 7 postoperative deaths in this series of 245 cases of chemopallidectomy—a mortality rate of 2.8 per cent. Four patients died from two to nine days following operation as a result of deep hemorrhage in the region of the basal ganglia; 1 died two weeks after operation from renal failure; 1 died twenty-four hours after operation from acute, irreversible, cerebral edema; and 1 patient who was in a lingering, vegetative state died from aspiration pneumonia ten weeks after surgical intervention.

The precise cause and source of deep hemorrhage in these cases is not entirely clear. One cannot be certain whether the hemorrhage was secondary to placement of the cannula, injection of the destructive medium, or both. It is quite likely that the mortality rate for chemopallidectomy can, with meticulous attention to operative and postoperative details, be maintained at 3 per cent or less, even though the operation be carried out in disabled patients in whom the disease is far advanced.

Motor deficits

There were 5 cases of hemiplegia or hemiparesis subsequent to chemopallidectomy. Invariably this complication occurred twenty-four hours or more following operation. In these instances the cause of the neurologic complication was believed to be an increase in the area of destruction around the primary operative site, so that the destruction spread into the adjacent internal capsule. One patient became severely hemiplegic approximately eight hours following the operation, during a period of vascular hypotension. Subsequent arteriography in this patient demonstrated a complete thrombosis of the internal carotid artery on the side of operation.

The incidence of hemiparesis or hemiplegia as a complication of chemopallidectomy was 2 per cent in our series.

Mental disturbances

During the first postoperative week certain transitory mental phenomena, such as hypersomnolence, transient confusion, negativism, and impaired memory for recent events are not infrequent. Usually, these symptoms are of minor consequence. In a few cases, particularly in patients showing considerable mental deterioration, electroencephalographic abnormalities and emotional disturbances prior to operation, a confusional state may be observed which lasts for eight to ten weeks following operation.

One of the most interesting syndromes which we noted during the first two

postoperative weeks was a condition of negativism and catatonia which occurred in approximately 15 per cent of severely incapacitated patients who demonstrated some degree of deterioration and vegetative abnormality preoperatively. During this negativistic state the patient, although obviously conscious, will not respond to questions or commands, will not willingly take nourishment, and will not demonstrate any obvious interest in, or reaction to his environment. During this period he will maintain the extremities in a fixed posture if they are placed in this posture by the examiner. Usually, he fails to respond even to extremely painful stimuli. Occasionally, such a patient makes no effort to clear secretions from his own throat, thus increasing the danger of aspiration during the postoperative period.

During the early part of our experience with this operation we hesitated to carry out any re-injection procedures in such negativistic or catatonic patients postoperatively. For this reason, in some cases the indwelling catheter was removed. However, we have since learned that this state will usually respond to good nursing care and conservative management. Therefore, we now allow the cannula to remain in place during this period, while the patient is maintained by tube feedings and meticulous nursing care. Usually by the seventh to ninth day he will have responded enough to justify continuation of the postoperative injection program. The physiologic mechanisms underlying this negativistic or catatonic state deserve further attention.

Speech disturbances

Approximately 15 per cent of the 245 patients in this series showed a transient speech abnormality over and above the preoperative deficit during the early postoperative period. In some instances there was a decrease in vocal tone. In 3 patients there was mutism of one week's duration, even though the operative lesion had been made in a non-dominant cerebral hemisphere. Not infrequently, following the convexity operation on the dominant hemisphere, there was dysphasia lasting from seven to fourteen days. Invariably these abnormalities cleared spontaneously. Two patients have maintained aphasic sequelae of a severe nature.

Autonomic or vegetative symptoms

The occurrence of autonomic abnormalities—hyperthermia, hyperhydrosis and hypersalivation—following operation appears to be directly proportional to the degree of vegetativity of the patient preoperatively. These symptoms are seen most frequently in far advanced postencephalitic cases but occur in other cases as well. They invariably respond to meticulous nursing care.

Sometimes urinary retention constitutes a postoperative problem, but it always responds to the usual routine measures. Occasionally, particularly in the older age group, there is a tendency to nausea, vomiting and headache as a sequel of pneumoencephalography. It is for this reason that we postpone injection for twenty-four to forty-eight hours following placement of the cannula in

some cases. This allows the patient to recover fully from the effects of pneumoencephalography before a permanent lesion is made.

General

In this series, although we dealt with a chronically ill and debilitated group of patients, most of whom demonstrated in addition to tremor and rigidity, emotional problems, vegetative abnormalities and other sequelae of long-standing chronic disease, the overall incidence of lasting complications was relatively very low.

The principal complications of chemopallidectomy are a mortality rate of 2.8 per cent and a hemiplegia incidence of 2 per cent. Mental confusion, although usually transient in nature, may last as long as ten weeks. The other phenomena enumerated constitute a need for painstaking and meticulous postoperative care; but if such care is provided, these conditions will usually be transient. It is worthy of emphasis that in patients with unilateral parkinsonism or those in whom emotional and vegetative abnormalities do not exist, the postoperative course may be completely uneventful and not infrequently the patient will be able to leave the hospital from nine to fourteen days after operation.

DISCUSSION

On the basis of the foregoing data, an attempt can now be made to answer the questions which were posed in the first part of this paper. The answers are numbered in the order in which the questions were asked.

1. It is obvious at the present time that tremor and rigidity can, in many cases, be completely alleviated by neurosurgical intervention. Following anterior choroidal artery occlusion, 65 per cent of the patients in this personal series have been maintained in a state of complete freedom from tremor and rigidity since the time of operation. The follow-up period has been from one to four years. In the case of chemopallidectomy, lasting relief of tremor and rigidity has been achieved in 70 per cent of the cases in our series.

2. The complications which have ensued as a direct result of neurosurgical intervention (chemopallidectomy) are as follows: a mortality rate of 2.8 per cent; an incidence of hemiplegia of 2 per cent; and transient confusion or emotional distress in approximately 15 per cent. The overall incidence of severe postoperative complications (including death, hemiplegia, or mental or intellectual abnormalities) is 6 per cent.

3. The status of the patients who underwent surgery in this series invariably has been much better than that of a similar group of patients who were not operated upon. An informal survey of patients from our own clinic who were evaluated for surgery but not operated upon for various reasons has demonstrated that, without exception, the progression of disabling symptoms is relentless. In no patient in our experience who did not undergo surgery and whom we have followed for one year or more has the disease become spontaneously arrested or have disabling symptoms reversed themselves.

4. The question naturally arises as to how these particular techniques compare with other methods of therapy for parkinsonism. This is a conclusion that for the present is best left to the individual reader after he has studied the data presented in the reports in this volume, and has compared them with reports of other methods of medical and surgery therapy for parkinsonism. However, we believe that at the present time chemopallidectomy is the treatment of choice for many cases of moderately advanced and far advanced parkinsonism.

5. In summarizing the present status of these techniques, it is our opinion that anterior choroidal artery occlusion should be reserved for patients under the age of 55 who have had parkinsonism for a long time and are greatly incapacitated. Perhaps in clinics where there is insufficient material, or where for other reasons the technique of chemopallidectomy cannot be developed and perfected, anterior choroidal artery occlusion should be used for the occasional surgical case of parkinsonism. The possibilities of benefit and the risks involved in this operation can be clearly ascertained from the reports in this volume.

Chemopallidectomy is a relatively simple, accurate, safe and rewarding technique that can be applied without great risk and yet with the possibility of considerable benefit to a large number of parkinsonian patients in many different neurosurgical clinics. *At the present time, it is felt that one should not undertake this particular procedure unless he is willing to devote a considerable part of his time and attention, not only to the problem of surgical technique but to the problem of parkinsonism with its many ramifications.*

There is an additional element which a surgeon should seriously consider before diligently applying himself to a long-range program of surgery for parkinsonism. He must consider not only the psychologic make-up of the patient who is to be operated upon, but must seriously consider his own psychologic capability of withstanding certain aspects peculiar to the surgery of this disease.

The one outstanding factor that must be coped with is that if surgery is unsuccessful in relieving the patient's symptoms, this failure is clearly evident at all times to the patient, his family, the other patients on the ward, the referring physician, and a host of other interested parties. Unlike the results of operation for glioblastoma multiforme, in which replacement of a bone flap covers the obvious inability of neurosurgeons to relieve the disease, any degree of failure following the surgical treatment of parkinsonism is clearly manifested to the public by the continued shaking of one's patient. This often arouses considerable resentment in the patient in whom the operation has not been successful, and in a series of considerable size will invariably be a continuous source of distress to the surgeon. To paraphrase a rarely understood writer—in the case of surgery for parkinsonism, "a failure is a failure is a failure."

Thus, although one encounters a gratifying and often a remarkable degree of success in alleviating symptoms that were believed to be irreversible, one also encounters the constant reminder that we have not yet achieved the ability to be invariably successful in the treatment of this malady. This fact is mentioned principally in order that this report may state clearly and unequivocally the overall picture as regards results in our personal experience.

SUMMARY

This report summarizes the clinical results and follow-up studies in a personal series of 300 operations for parkinsonism. In all instances, the operation was either surgical occlusion of the anterior choroidal artery or chemopallidectomy. Beneficial results, complications, and transient postoperative abnormalities are discussed. It is hoped that this information will enable the interested reader to develop his own conclusions regarding the value of neurosurgical intervention for parkinsonism, and to compare results achieved in this series with those achieved by other medical and surgical techniques.

THE GLOBUS PALLIDUS AS A SURGICAL TARGET

IRVING S. COOPER, M.D. AND NICOLAS POLOUKHINE, M.D.

Until 1937 there was no serious neurosurgical attempt to relieve the symptoms of parkinsonism by inflicting destructive lesions in the central nervous system. However, in that year Bucy and Case (1) and Klemme (2) devised operations consisting of resection of the premotor cerebral cortex or the motor cerebral cortex, or both, in an attempt to alleviate resting tremor of the opposite extremities. Each of these operations results in a contralateral hemiplegia or hemiparesis, and relief of tremor is proportional to the sacrifice of motor power. Subsequent to these cortical operations, various other procedures have been devised in which the principal aim is to interrupt the pyramidal motor pathway either in the spinal cord or cerebral peduncle, thereby sacrificing motor power and concomitantly effecting a proportional decrease in parkinsonian tremor (3–6). The results of these procedures established the fact that pyramidal-tract operations can alleviate tremor only by the sacrifice of motor power; they cannot relieve rigidity, deformity, incapacitation or any of the other stigmata of parkinsonism.

A new vista in the surgery of parkinsonism was introduced by the observations of Meyers (7, 8), who performed a series of investigative basal-ganglia operations in various extrapyramidal disorders, commencing in 1940. Meyers experimented with a variety of these operations, among which were: 1) extirpation of the head of the caudate nucleus and interruption of fibers in the oral portion of the anterior limb of the internal capsule, 2) extirpation of the head of the caudate nucleus and the oral third of the globus pallidus and putamen, and 3) section of the fibers emerging from the mesial globus pallidus. He considered the latter operation the most effective of the three. However, Meyers' experience convinced him that the risks are too great to warrant the general use of any of these procedures for the treatment of parkinsonism. These operations of Meyers stand, therefore, principally as the forerunners of new and profitable investigations in the surgery of parkinsonism. Moreover, Meyers' courageous efforts have led to new concepts and a better understanding of the pathologic physiology of tremor and rigidity.

During the past ten years, various investigators have experimented with basal-ganglia operations for parkinsonism. Browder (9) developed the technique of capsulotomy, which involves removal of the upper third of the caudate nucleus and section of fibers in the anterior limb of the internal capsule. This operation produces a paresis which Browder states largely disappears, although reduction of tremor and rigidity are said to persist even when motor power returns.

An important avenue of investigation was opened by Spiegel and Wycis (10–12), who developed a stereotactic instrument for precision localization of lesions to be made deep in the human brain. Using pneumoencephalography, they identified the anterior commissura and foramen of Monro and placed a depth electrode in the region of the ansa lenticularis stereotactically. They preferred electrolytic production of lesions. Although these workers pioneered in human

stereotaxis and developed this complicated method, a sizable series of cases of parkinsonism operated on by their technique has not yet been presented. Thus, an evaluation of the method on the basis of long-range results in a large series of cases cannot be made. Although it is apparent that the introduction of stereotactic techniques constitutes a significant contribution, it remains to be seen whether it will become a practical surgical method amenable to general usage.

Some investigators have developed their own stereotactic instruments for production of deep intracerebral lesions in parkinsonism and other extrapyramidal disorders (13, 14). Narabayashi *et al.* (15–17) injected procaine in oil into the globus pallidus stereotactically for parkinsonism. This procedure relieves rigidity but Narabayashi stated that tremor invariably recurred postoperatively. It is our opinion that this recurrence of tremor in Narabayashi's cases is probably related to the fact that procaine in oil is incapable of causing a neurolytic lesion extensive enough to induce permanent alleviation of tremor.

It is apparent from the work of several independent observers that one can place a lesion in the globus pallidus without the aid of a complicated stereotactic instrument. This does not imply that such instruments are not noteworthy. However, from an immediate practical standpoint, an electrode or a cannula can be efficaciously and accurately placed by hand or with a simple needle holder without the aid of complicated stereotactic instrumentation. Fenelon *et al.* (18–20), in Paris, devised a direct method for subpallidal or ansa-lenticularis coagulation without the use of a stereotactic instrument or roentgenographic control. He reported lessening of both tremor and rigidity following placement of an electrolytic lesion in the ansa lenticularis. Guiot and Brion (21–23) also carried out direct coagulation of the mesial globus pallidus and ansa lenticularis by way of a subfrontal approach after placing a small frontal bone flap in the skull. Salutary results have also been reported by Guiot in parkinsonism and other dyskinetic disorders. Other workers have devised procedures which enable them to approach the globus pallidus or its environs and produce a lesion there (24). Without question, at this early stage of basal-ganglia surgery, each of these investigators has contributed much to the overall problem.

In 1952, the operation of anterior choroidal artery occlusion was added to the neurosurgical operative techniques for advanced parkinsonism (25–27). The purpose of occluding this artery is to produce infarction of the medial globus pallidus and its efferent pathways. In a series of 55 cases, we demonstrated that occlusion of the anterior choroidal artery can alleviate the tremor, rigidity and deformity of parkinsonism and reduce incapacitation to a remarkable degree in certain cases. Although the beneficial results of this procedure in relieving tremor and rigidity have been confirmed by many neurosurgeons, there are certain limitations. The principal one is that the anterior choroidal artery may vary in individual cases, and therefore the size and the extent of the lesion produced by its occlusion become dependent, at least in part, on the anatomic distribution of the artery—a factor which is beyond the control of the surgeon. Moreover, the operation is hazardous for patients over the age of 55. Therefore, in 1953 (28–30) we developed the operation of chemopallidectomy, which is a

simple, reasonably safe, effective method for alleviation of the tremor and rigidity of parkinsonism, as well as other hyperkinetic manifestations.

Chemopallidectomy involves the placement of a polyethylene catheter, by a simple direct technique, into the globus pallidus. The position of the cannula is then checked roentgenographically. Following correct placement, procaine is injected through the cannula to obtain a physiologic-therapeutic corroboration of its position. When the position is correct, the procaine injection results in alleviation of contralateral tremor and rigidity without impairing motor function. A permanent neurolytic lesion and lasting clinical result is then obtained by injection of absolute alcohol.

It is our opinion, on the basis of documented results up to the present time, that chemopallidectomy is the neurosurgical treatment of choice of parkinsonian tremor and rigidity. To that end, it is our purpose in this article to demonstrate the anatomic basis for chemopallidectomy, the neuroanatomic-radiologic orientation for the procedure, and the technical details of the operation as it is now being carried out on our service.

TOPOGRAPHIC ANATOMY

The cross anatomy of the globus pallidus can be studied in detail in many anatomic texts and, better yet, by examination of anatomic specimens. It is our purpose here only to note those anatomic features which are particularly germane to this subject of the globus pallidus as a surgical target.

The globus pallidus is a nucleus of gray matter situated deep in the medullary substance of the cerebral hemisphere (Fig. 1). It is an elongated triangle with its base laterally. The lateral border of the pallidum adjoins the putamen. The most anterior portion of the pallidum is adjacent to the anterior commissura, but its medial and posterior borders are adjacent to the internal capsule. This relationship with the internal capsule is of the utmost importance when one considers placing a destructive lesion in the medial portion of the globus. Moreover, in our experience, one must locate a large lesion in both the medial and posterior portions of the globus if there is to be permanent elimination of any tremor of considerable magnitude from the contralateral extremities. Thus, this relationship must be constantly borne in mind.

The cross section of the cerebral hemisphere visualized in Figure 1 demonstrates graphically the location of the globus pallidus and its relationship to the internal capsule, putamen, insula, and particularly to the lateral and third ventricles. This latter relationship is of great importance in establishing radiographic landmarks which enable one to place a cannula into the mesial globus pallidus during the operation of chemopallidectomy. The close relationship of the ansa lenticularis to the optic chiasm is clearly evident in Figure 1. Also noted are the two principal approaches—the subtemporal approach and the convexity approach—to the globus pallidus for chemopallidectomy.

Figure 2 portrays an attempt to demonstrate the globus pallidus diagrammatically in three dimensions. Of particular interest in this figure, is the spacial relationship of the globus pallidus to the caudate nucleus, the thalamus, and

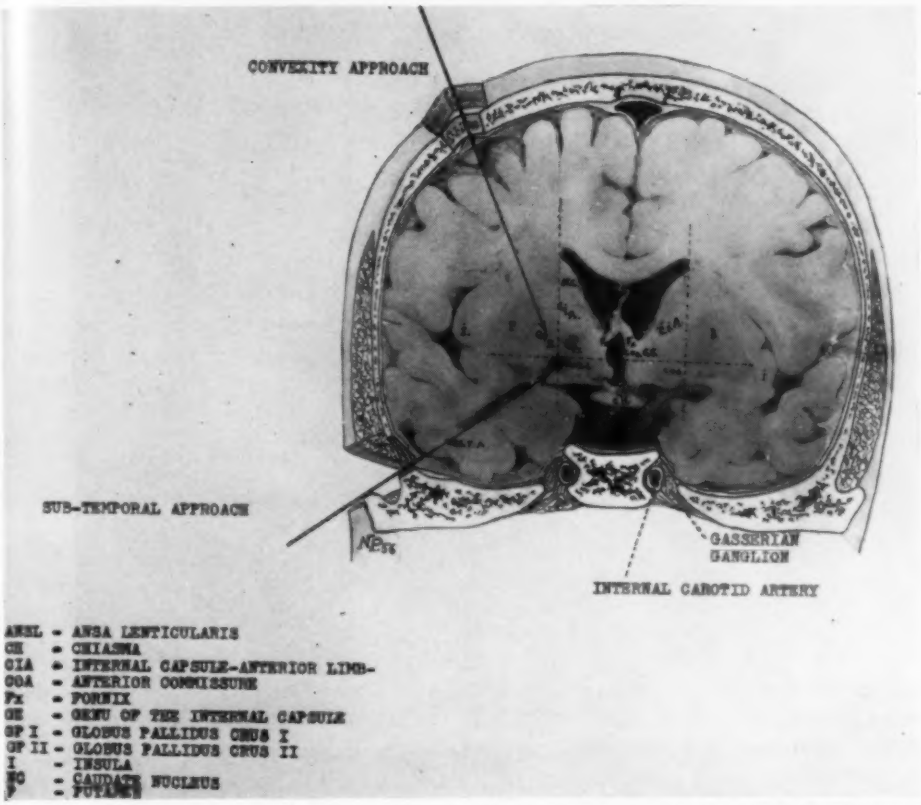

CONVEXITY APPROACH
SUB-TEMPORAL APPROACH
GASSERIAN GANGLION
INTERNAL CAROTID ARTERY
ANSL - ANSA LENTICULARIS
CH - CHIASMA
CIA - INTERNAL CAPSULE-ANTERIOR LIMB-
COA - ANTERIOR COMMISSURE
Fx - FORNIX
GE - GENU OF THE INTERNAL CAPSULE
GP I - GLOBUS PALLIDUS GNUS I
GP II - GLOBUS PALLIDUS GNUS II
I - INSULA
NC - CAUDATE NUCLEUS

FIG. 1. Semi-diagrammatic representation of the anatomy of the globus pallidus and the relationship of this structure to the lateral ventricles, the third ventricle, and the structures in the basilar cisterns. The subtemporal and convexity approaches to the mesial globus pallidus are also indicated.

certain pathways passing in close proximity to the globus pallidus which conceivably might be damaged during any surgical procedure in the mesial globus. The relationship of the subtemporal and convexity approaches to the mesial globus is also shown.

NEUROANATOMIC RADIOLOGIC CORRELATION

During the operation of chemopallidectomy, pneumoencephalography is used for correct orientation of the needle in the mesial globus pallidus. The aim is to place the cannula in the globus pallidus, but in such a position intracerebrally that when roentgenograms are made, the cannula will appear in the area which coincides with the mesial globus. Therefore, it is of the utmost importance that the surgeon be well oriented in regard to pneumoencephalography and, more particularly, in regard to pneumoencephalographic landmarks which he can relate to the globus pallidus and thus orient himself before and during operations in this area.

In Figure 3 we have superimposed a diagrammatic drawing of the globus pallidus and putamen upon a normal pneumoencephalogram in which the third and

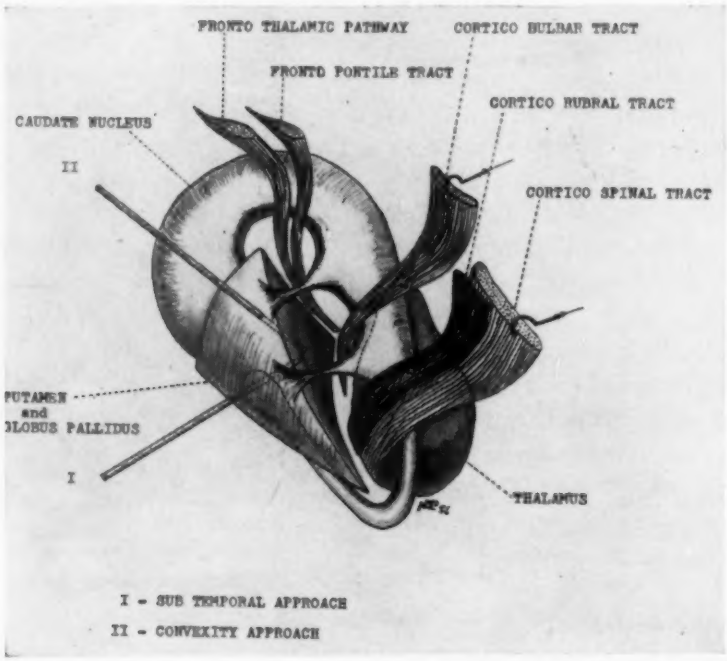


FIG. 2. Diagrammatic representation of the globus pallidus in three dimensions, demonstrating the relationship of this structure to the thalamus, caudate nucleus, and certain long fiber tracts.

lateral ventricles have been filled with air. It may be seen that, if one draws a horizontal line through the middle of the third ventricle, this line will pass through the mesial globus pallidus in approximately the center of the structure. If one then drops a vertical line from the lateral portion of the body of the lateral ventricle, this vertical line will intersect the horizontal line at approximately the junction of the middle and lateral segments of the globus pallidus. Forearmed with this information one can then determine that the point of intersection of a vertical line dropped from the lateral portion of the body of the lateral ventricle and a horizontal line extended from the middle of the third ventricle will mark a point approximately in the center of the junction of the medial and lateral segments of the globus pallidus. Therefore, when one directs a cannula towards the mesial globus pallidus during the operation of chemopallidectomy, using pneumoencephalography as a guide, this point can be used as a landmark in demonstrating the approximate position of the junction of the medial and lateral segments of the globus pallidus.

We usually aim our cannula so that its tip lies approximately 2 millimeters medial to the juncture of the vertical and horizontal lines just described, with the outlet located directly upon the plane indicated by this horizontal line extending from the middle of the third ventricle. The point at which we aim is marked by an "X" in Figure 3.

For orientation in the antero-posterior plane, the lateral pneumoencephalogram is used. Our best results have been obtained when the tip of the cannula

FIG. 3. An antero-posterior pneumoencephalogram upon which has been superimposed a diagrammatic representation of the globus pallidus and putamen. Note that a horizontal line extended from the middle of the third ventricle and a vertical line dropped from the tip of the lateral ventricle intersect in the mesial globus pallidus. The point of intersection of these two lines forms one of the landmarks used in the technique of chemopallidectomy. "X" indicates the point at which the brain cannula is directed during this procedure.

lies approximately between 3 and 5 millimeters behind the center of the foramen of Monro. The lateral plane for insertion of the cannula, determined by pneumoencephalography, is indicated by the letter "O" in Figure 4.

There are a great many additional points of academic and anatomic interest as regards the use of pneumoencephalography for the procedure of chemopallidectomy or for other basal-ganglia operations. However, the crux of the matter is this: one must establish pneumoencephalographically the approximate point at which a lesion must be placed in order to alleviate contralateral tremor and rigidity. *In our experience the most favorable point at which to make a lesion, as determined by the antero-posterior pneumoencephalogram, is that designated as point "X" in Figure 3. The most favorable point at which to make a lesion, as determined by the lateral pneumoencephalogram, is that designated as "O" in Figure 4.* Therefore, we aim at these reference points in order to place the tip of the cannula in the media globus pallidus. Thus, we are enabled to place a lesion of suitable size in this structure. Such anatomic radiologic correlation forms the basis for insertion of the cannula into the globus pallidus during the operation of chemopallidectomy.

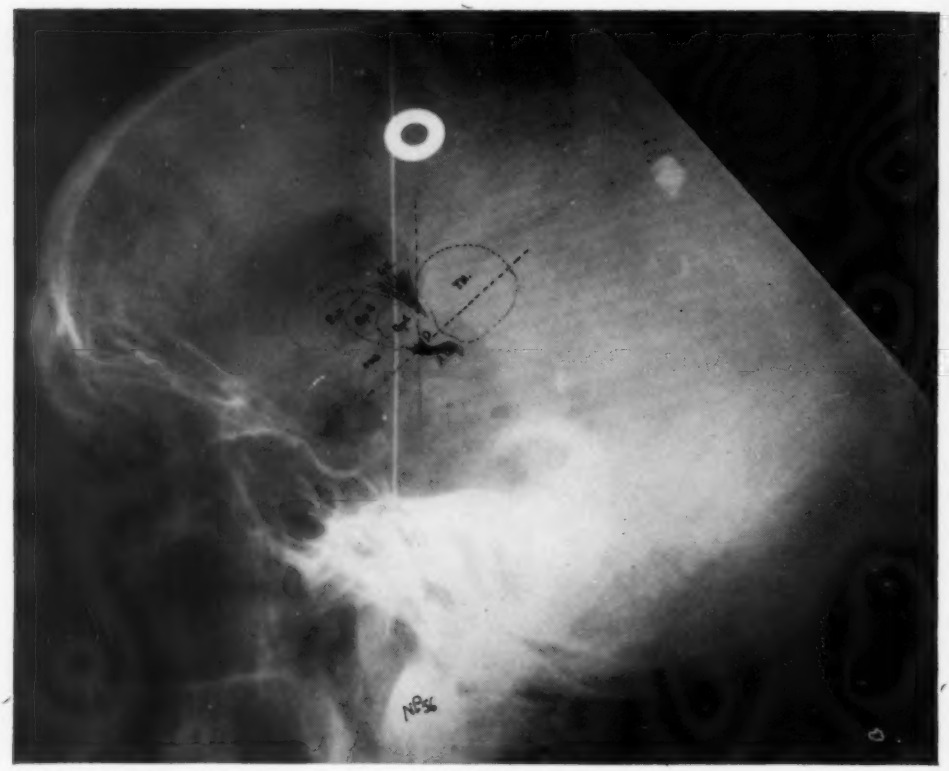


FIG. 4. A lateral pneumoencephalogram demonstrating the third ventricle, foramen of Monro and anterior portion of the lateral ventricles. A diagrammatic sketch of the caudate nucleus, putamen, globus pallidus, thalamus and ansa lenticularis has been superimposed upon this pneumoencephalogram. "O" marks the plane in which the brain cannula is introduced during the procedure of chemopallidectomy.

TECHNIQUE OF CHEMOPALLIDECTOMY

The aim of the pneumoencephalographic procedure is to place a cannula in the brain so that its open end lies in the mesial portion of the globus pallidus. One might modify this statement for the surgeon by stating that the aim of the technique of chemopallidectomy is to place a cannula deep in the brain with its open end in such a position that, when this position is checked by pneumoencephalography, the end of the cannula lies at point "X" in the antero-posterior pneumoencephalogram (Fig. 3) and at point "O" in the lateral pneumoencephalogram (Fig. 4).

We use two principal approaches to this problem of correctly placing the cannula in the mesial globus pallidus. One is the subtemporal, and the other is the convexity approach. Each has been found to serve satisfactorily, although the latter appears to be the simpler of the two.

Preoperative pneumoencephalography

Prior to operation we attempt to mark on the scalp the approximate plane of the foramen of Monro so that this plane can serve as a landmark for external

orientation towards the intracerebral structures during the operation. The marking is carried out in the following manner. Pneumoencephalography is performed, using approximately 25 to 30 cubic centimeters of air. The head is positioned during the insertion of air and the subsequent roentgenography so that the air fills the anterior horns of the lateral ventricle, the foramina of Monro and the anterior half of the third ventricle as well as the interpeduncular cistern.

Prior to taking the roentgenographic films, a piece of tantallum wire is placed on the scalp at a point 14 centimeters behind the nasion, perpendicular to the zygoma (Figure 5). When the lateral pneumoencephalogram is made, the line formed by the shadow of this wire will usually pass through the center of the foramen of Monro. If it does not, the tantallum wire is relocated at an appropriate distance and the roentgenogram is repeated until the line does coincide with the plane that passes through the center of the foramen of Monro (Figs. 6 and 7). This line that corresponds to the foramen of Monro is then lightly scratched onto the scalp so that it will remain visible through the operation.

The scalp incision is made in the plane indicated by this line. If the subtemporal approach is to be used, the incision is made above the zygoma. If the convexity approach is to be used, the incision is made with its center approximately 6 centimeters from the midline of the skull. In either case, the trephine opening is centered on the line which indicates the plane of the foramen of Monro.

FIG. 5. The position of the patient on the x-ray table while the lateral pneumoencephalogram is being made. With the patient in this position, the air can enter the anterior third ventricle, foramen of Monro and anterior portion of the lateral ventricles. Beneath the piece of adhesive tape on scalp is a tantallum wire which has helped in locating the plane of the foramen of Monro in this lateral pneumoencephalogram. (The x-ray film is shown in Figure 6.)

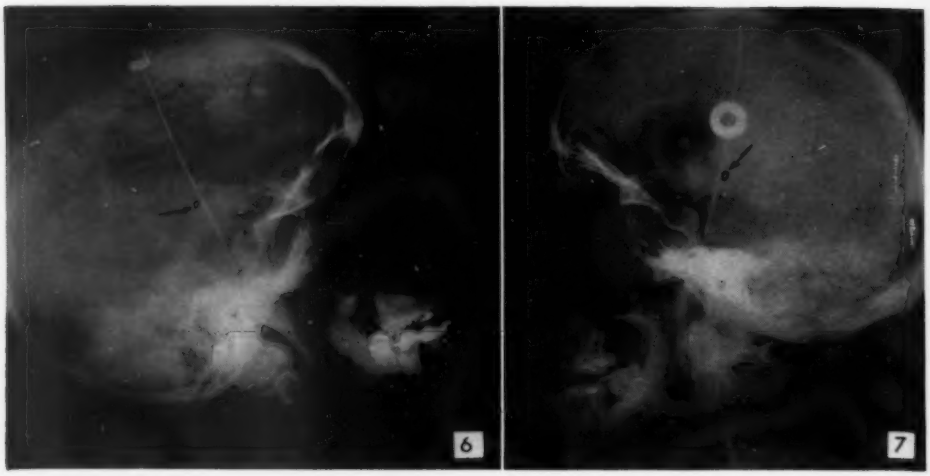


FIG. 6. A lateral pneumoencephalogram, upon which the plane of the foramen of Monro is indicated by a shadow cast on the film by the tantallum wire shown in Figure 5. "O" indicates the approximate point at which the cannula is aimed in this plane during the procedure of chemopallidectomy.

FIG. 7. Preoperative pneumoencephalogram in which the proper plane for passage of the brain cannula has been indicated. "O" designates the point at which the cannula is directed during this procedure.

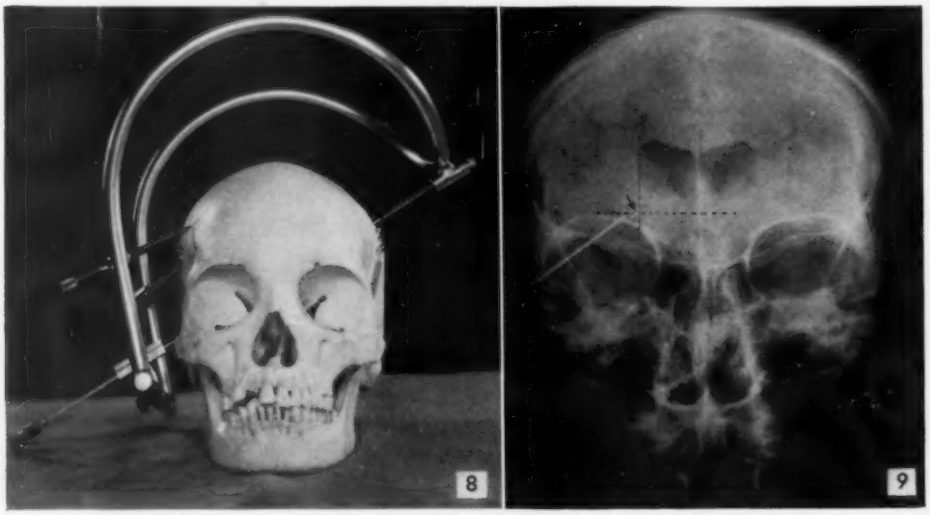


FIG. 8. Demonstration of the position of the pallidectomy guide and polyethylene brain cannula during the subtemporal approach to the globus pallidus. (More complete details of this particular approach to the globus appear in an earlier publication (30)).

FIG. 9. Antero-posterior pneumoencephalogram taken during subtemporal chemopallidectomy. The arrow points to the site of the lesion. Note that the lesion corresponds to the intermediate segment of the globus pallidus. The patient was completely relieved of contralateral tremor and rigidity following the operation. There has been no recurrence of symptoms during the follow-up period of more than a year.

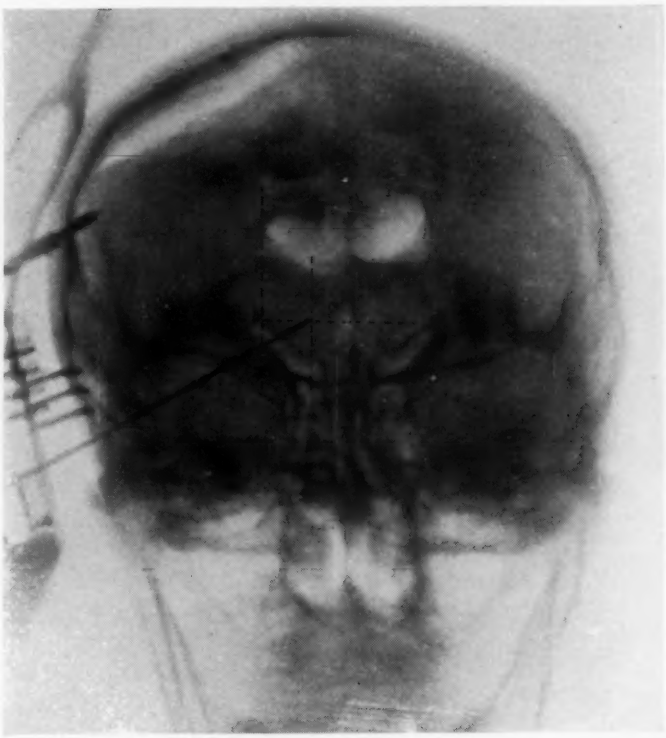
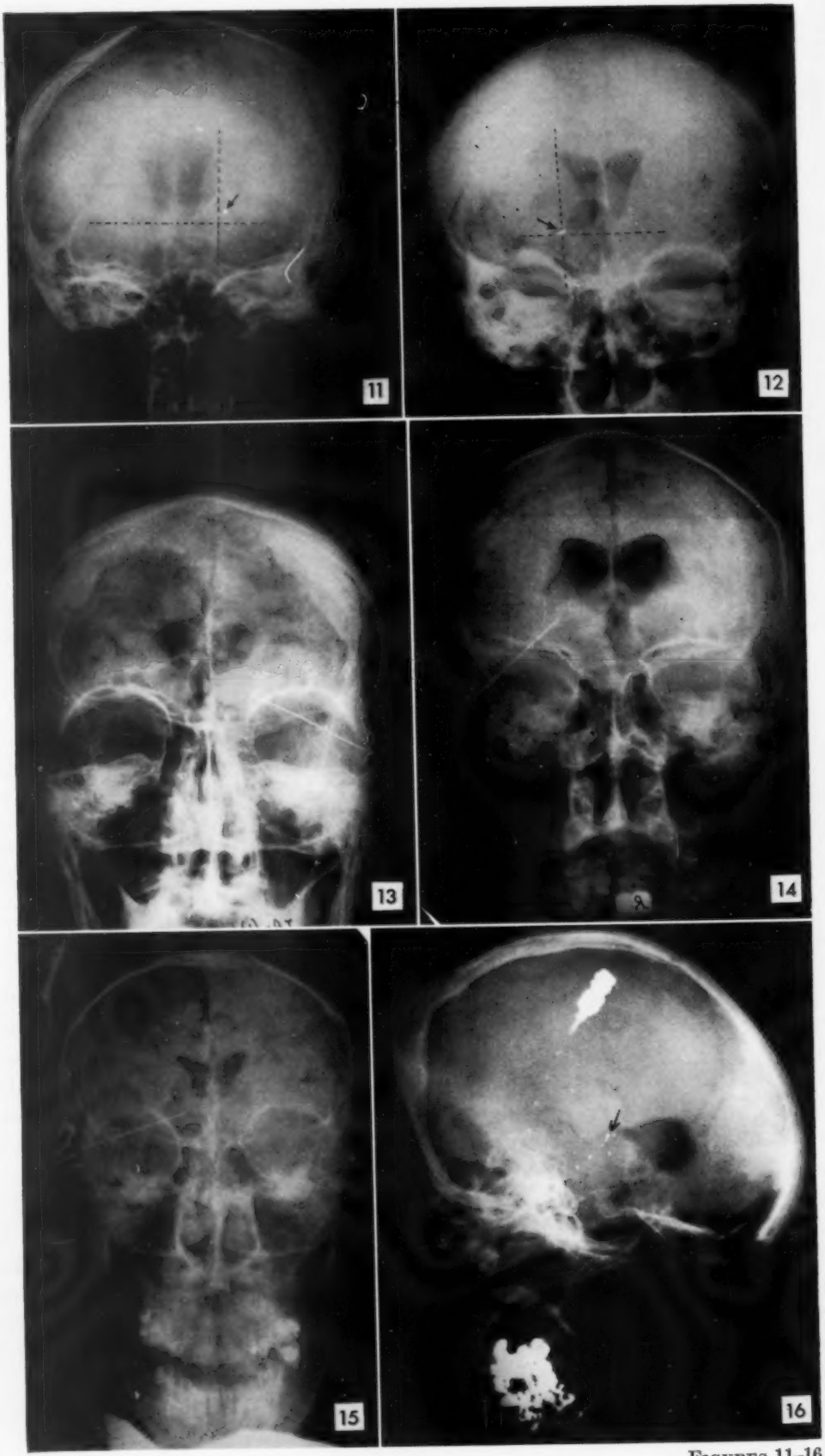


FIG. 10. Antero-posterior pneumoencephalogram taken during a subtemporal chemopallidectomy. Note that the lesion was made in the mesial tip of the globus pallidus. This case was one of violent unilateral tremor. The tremor was completely alleviated by chemopallidectomy and relief has persisted for eighteen months up to the present time. In this case the good result followed neurolytic destruction at a site which was somewhat different from that represented in Figure 9.

The subtemporal approach

In a previous issue of this journal (30), the specific technique for the subtemporal approach to the globus pallidus was described in detail. A detailed analysis of the subtemporal approach, with diagrammatic representations of each step of the surgical procedure, has since been published in monograph form (31). Therefore, it is not necessary to repeat the details of this approach to chemopallidectomy. The basic facts are evident in Figures 8 through 21. In Figures 9 through 21 are represented antero-posterior and lateral pneumoencephalograms which demonstrate the position of cannulae placed in the mesial globus pallidus by the subtemporal approach. It may be seen that the cannula is not in an identical position in each case. One must check correctness of cannula localization not only roentgenographically but also physiologically, *i.e.*, by intracerebral procaine injection. Each of these roentgenograms represents a case in which excellent relief of tremor and rigidity was obtained following production of a lesion by alcohol or by Etopalin (Ciba) at the site of the arrow.



FIGURES 11–16

The convexity approach

The convexity approach has the same basic aim as the subtemporal approach. A polyethylene cannula is passed down through the convexity of the cerebral hemisphere so that its end is localized at a point represented by point "X" in Figure 3 and point "O" in Figure 4.

For this approach, an incision is made along the line which indicates the plane of the posterior border of the foramen of Monro—determined by the tantallum wire placed on the scalp during preoperative pneumoencephalography. The center of the incision is approximately 6 centimeters from the midline of the skull. A small trephine opening is made immediately beneath the incision and the dura opened in a cruciate fashion. The needle holder or pallidectomy guide is placed on the head so that the portion of the guide which holds the cannula lies immediately above the trephine opening and in the plane of the foramen

FIG. 11. Antero-posterior pneumoencephalogram made during a subtemporal chemopallidectomy. An arrow points to the site of the lesion. The patient was a 52-year-old woman in whom operation resulted in complete alleviation of tremor and rigidity of the contralateral extremities. Relief has persisted for more than one year since operation.

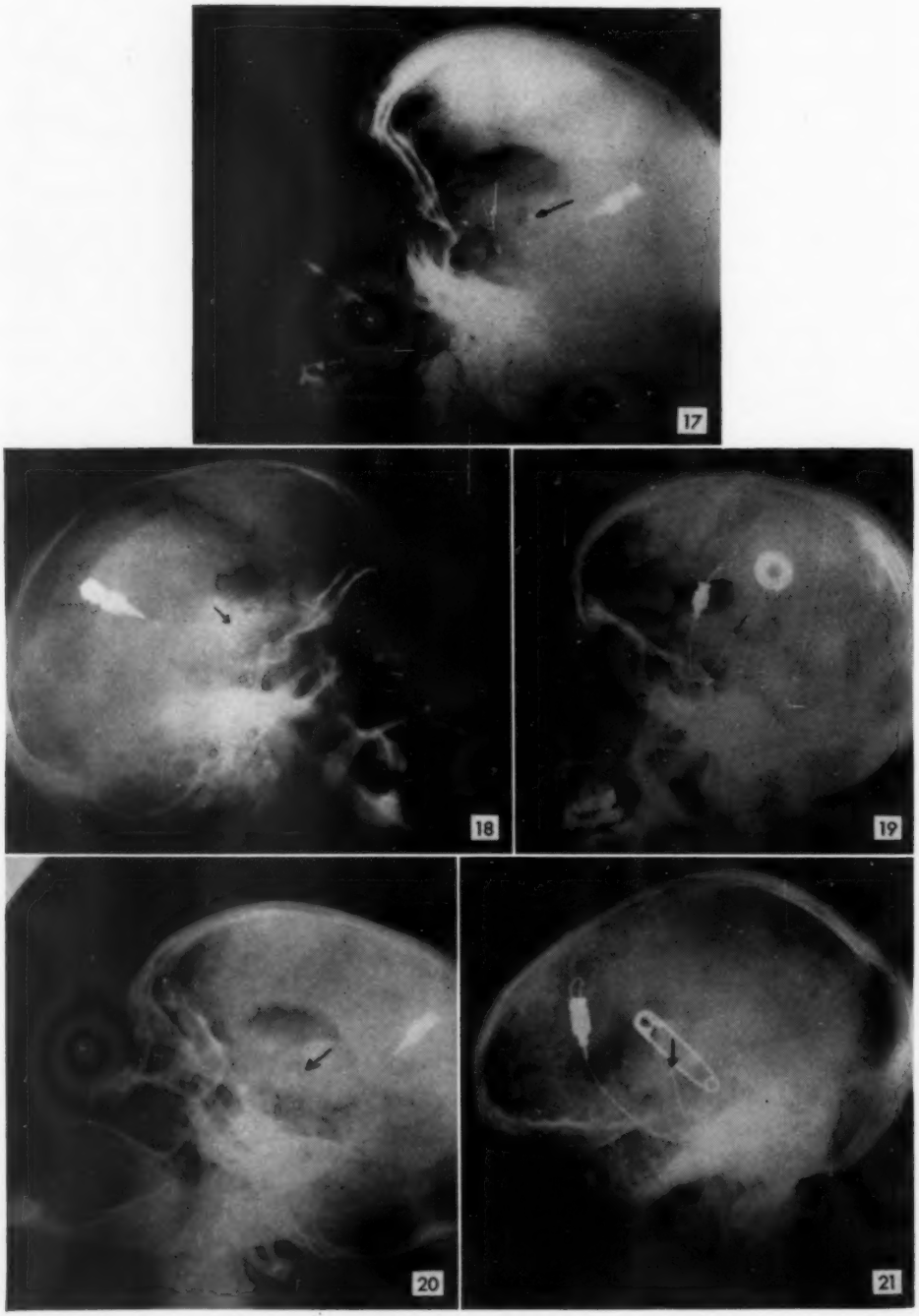
FIG. 12. Antero-posterior pneumoencephalogram showing the site of the lesion produced by subtemporal chemopallidectomy. The arrow points to a piece of silver clip such as is sometimes passed through the brain cannula to remain at the site of the lesion as a permanent radiographic landmark. The patient was a 54-year-old female with violent bilateral tremor. Tremor of the left extremities was completely alleviated by the chemopallidectomy. Relief has persisted for more than one year up to the present time.

FIG. 13. Antero-posterior pneumoencephalogram made during a subtemporal chemopallidectomy. The subtemporal approach to the globus pallidus is indicated by the stylet of the brain cannula. The patient was a 36-year-old white male who had suffered from postencephalitic parkinsonism for twenty years. He was completely incapacitated by bilateral tremor and rigidity. The left subtemporal chemopallidectomy represented in this film resulted in complete alleviation of the tremor and rigidity of the right extremities. The relief persisted and one year later operation was performed by the convexity approach, for treatment of the contralateral extremities (Fig. 30). At present this patient is relieved of bilateral symptoms by chemopallidectomies (bilateral) performed one year apart. The first operation was carried out by the subtemporal approach and the second operation by the convexity approach.

FIG. 14. Antero-posterior pneumoencephalogram showing the location of the brain cannula in a successful chemopallidectomy. The operation resulted in complete alleviation of contralateral tremor and rigidity. The ventricles are larger than normal in this case but the landmarks for placement of the cannula remain constant. On careful scrutiny, a silver clip can be seen in the basilar cistern on the side of the head contralateral to that in which chemopallidectomy was performed. This silver clip indicates the site of a left anterior choroidal artery occlusion which was performed two years prior to the chemopallidectomy. The anterior choroidal artery occlusion completely alleviated tremor and rigidity of the right extremities. Thus, following successful chemopallidectomy two years later the patient was relieved of tremor and rigidity bilaterally.

FIG. 15. Antero-posterior pneumoencephalogram showing the location in the mesial globus pallidus, of a brain cannula introduced by the subtemporal approach. This patient was relieved of contralateral tremor and rigidity and this alleviation has persisted for more than eighteen months up to the present time.

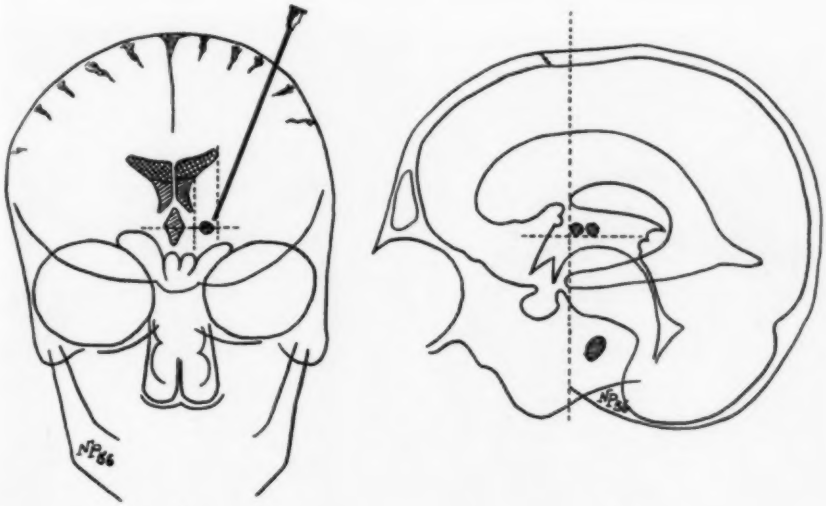
FIG. 16. Lateral pneumoencephalogram showing the proper location for the tip of the brain cannula in chemopallidectomy. (Same case as that in Figure 11.)



FIGURES 17–21

of Monro. The guide is then fastened to the head by fixing its three points firmly into the scalp. Scalp fixation of the instrument will usually suffice, since it weighs only 6 ounces; bony fixation is not necessary.

With the pallidectomy guide secured in this fashion, the bridge holding the



A B

FIG. 22 (a). Diagrammatic representation of a pneumoencephalogram demonstrating the approximate position of the brain cannula during the convexity approach to the mesial globus pallidus. The site of the desired lesion is indicated by the shaded circle in this figure.

FIG. 22 (b). Diagrammatic representation of a lateral pneumoencephalogram. The two shaded circles indicate the two points which represent satisfactory sites of lesions in the globus pallidus in our series. It is important that in some cases contralateral tremor and rigidity have been relieved by lesions made at the site represented by the anterior shaded circle, whereas in others the successful lesion was located at the site represented by the posterior shaded circle. When the two-cannula technique is used on one side, a lesion is made at each of these sites. In general, a lesion made at the site represented by the anterior shaded circle will result in more complete relief of rigidity than of tremor, but a lesion made at the site indicated by the posterior shaded circle will usually result in relief of both tremor and rigidity.

cannula necessarily lies in a plane immediately posterior to the foramen of Monro; this plane of insertion of the cannula is thereby fixed and predetermined by the surgeon. Thus, it is necessary to aim the needle in a medial direction from the trephine opening towards the globus pallidus (Fig. 22). Usually, when the burr hole is placed about 6 centimeters from the midline of the skull, one can use the inner canthus of the ipsilateral eye as an approximate point towards which to guide the cannula (Figs. 23 and 24). Although this sounds like a rather gross

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FIG. 17. Lateral pneumoencephalogram showing a successfully placed cannula during the technique of chemopallidectomy. (Same case as that in Figure 12.)

FIG. 18. Lateral pneumoencephalogram showing a successful case of chemopallidectomy.

FIG. 19. Lateral pneumoencephalogram in the patient represented in Figure 13, showing that the correct position for a successful result is not identical in each case.

FIG. 20. Lateral pneumoencephalogram showing a correctly placed brain cannula in this plane. The patient has been relieved of tremor and rigidity for more than eighteen months since operation.

FIG. 21. Lateral pneumoencephalogram showing the position of the brain cannula in a case of subtemporal chemopallidectomy. The patient was relieved of contralateral tremor and rigidity and the relief has persisted for more than fifteen months to the present time.

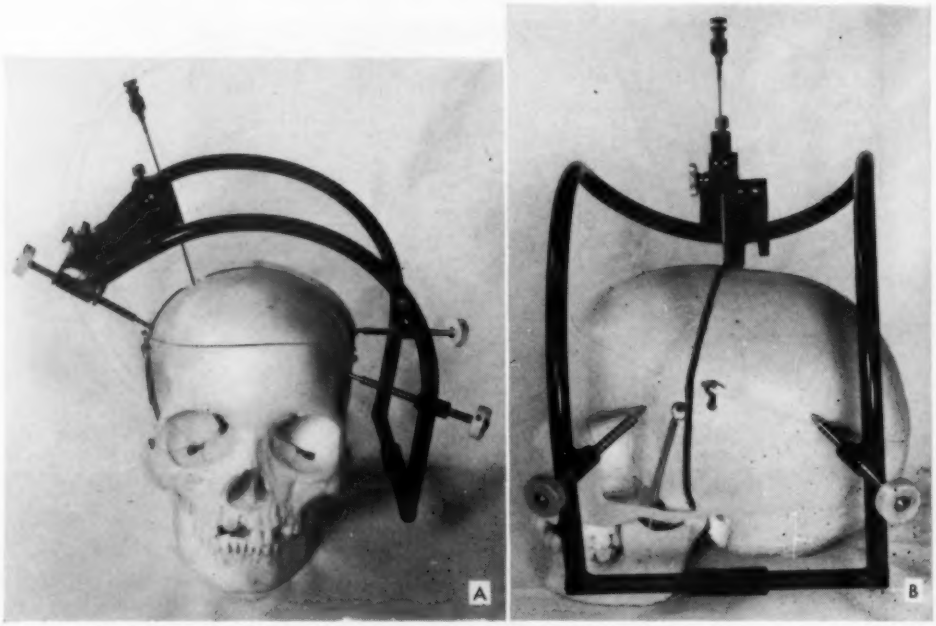


FIG. 23(a). Proper position of the pallidectomy guide for the convexity approach to chemopallidectomy. The brain cannula is being held correctly by the pallidectomy guide.

FIG. 23(b). Lateral view of the properly placed pallidectomy guide during the convexity approach for chemopallidectomy.

landmark for use in such a delicate procedure, we have found it to be quite satisfactory as an initial point at which to aim.

Figures 23 and 24 demonstrate the position of the pallidectomy guide on the skull when the convexity approach is used. The guide is placed on the head so that the cannula holder is immediately above the burr hole in the plane of the foramen of Monro, and the needle is aimed in the direction of the inner canthus of the eye. After the needle has been inserted 2 or 3 centimeters into the brain, its position is checked roentgenographically (Figs. 25 and 26). These roentgenographic checks during the operation are made with polaroid x-ray film, which is developed in the operating room within 50 seconds. This permits evaluation of the position and direction of the penetrating cannula in a matter of seconds, so that corrections can be made if necessary with a minimal lapse of time.

In Figure 25 is shown the antero-posterior pneumoencephalogram made with polaroid film during the operation. It may be seen that the cannula has entered the cerebrum to a depth of approximately 3 centimeters. This film demonstrates that a needle which was aimed by using the landmark of the inner canthus of the eye was also directly aimed at point "X" which represents the mesial globus pallidus. Such a roentgenographic check informs the surgeon that the cannula is directed along the proper route as regards this plane of orientation.

In Figure 26 is shown the lateral pneumoencephalogram made in the same patient with the x-ray polaroid developer. *It may be noted that the cannula is penetrating the plane which was indicated preoperatively by the tantallum wire placed*

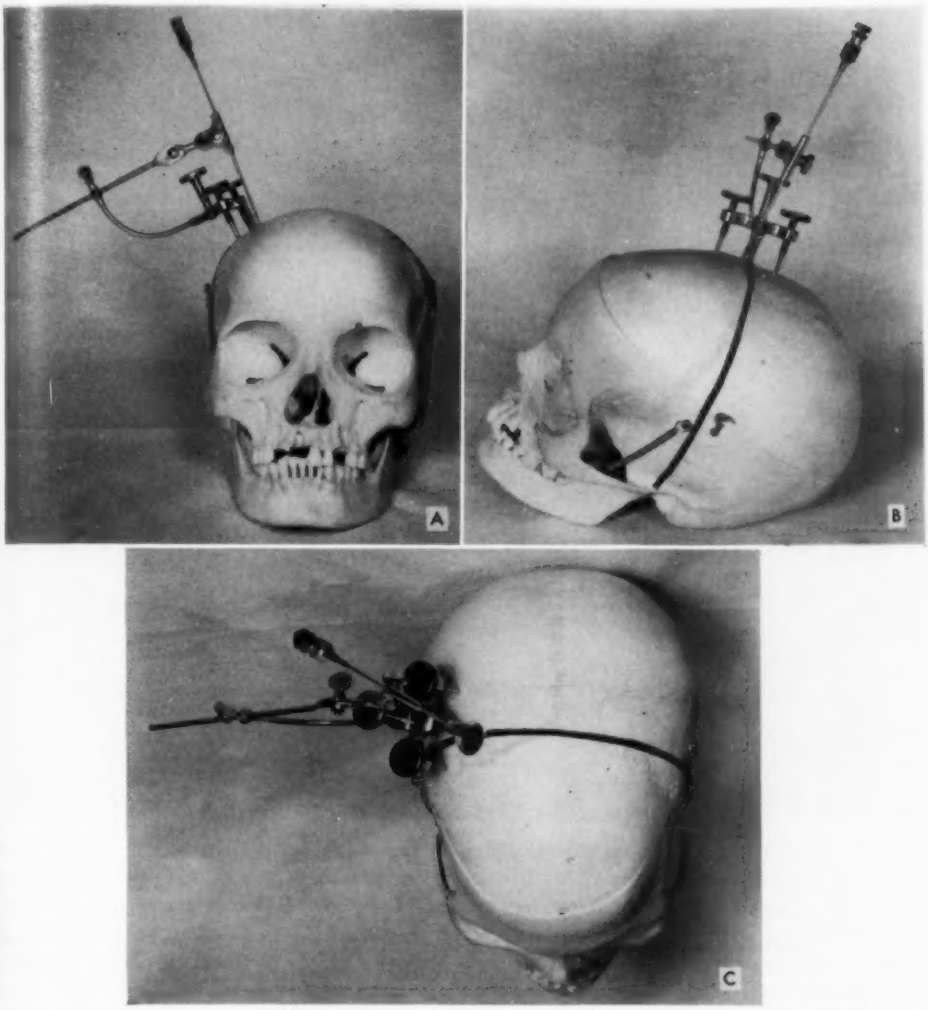


FIG. 24(a). A new simplified cannula holder currently in use for chemopallidectomy. The figure demonstrates clearly that this instrument is merely a cannula holder and that the guiding of the cannula to the globus pallidus must be carried out by the surgeon and not by the instrument. The pallidectomy needle holder indicated in Figure 23 should be used until a wide experience has been developed with this procedure; then this more simplified instrument will probably suffice.

FIG. 24(b). Lateral view of the simplified chemopallidectomy cannula holder. The black line on the skull indicates the plane of the foramen of Monro.

FIG. 24(c). A superior or bird's eye view of the trephine opening, simplified cannula holder, and cannula in the convexity approach to the globus pallidus.

on the scalp, being the line of orientation for placement of the pallidectomy guide. This lateral roentgenogram shows that the brain cannula is being inserted in the proper plane and that further extension of the cannula into the brain will result in achievement of the proper position at point "O".

Figures 27 and 28 portray the position of the cannula in the same patient after it had been pushed to its proper depth of 6.3 centimeters beyond the cortex.

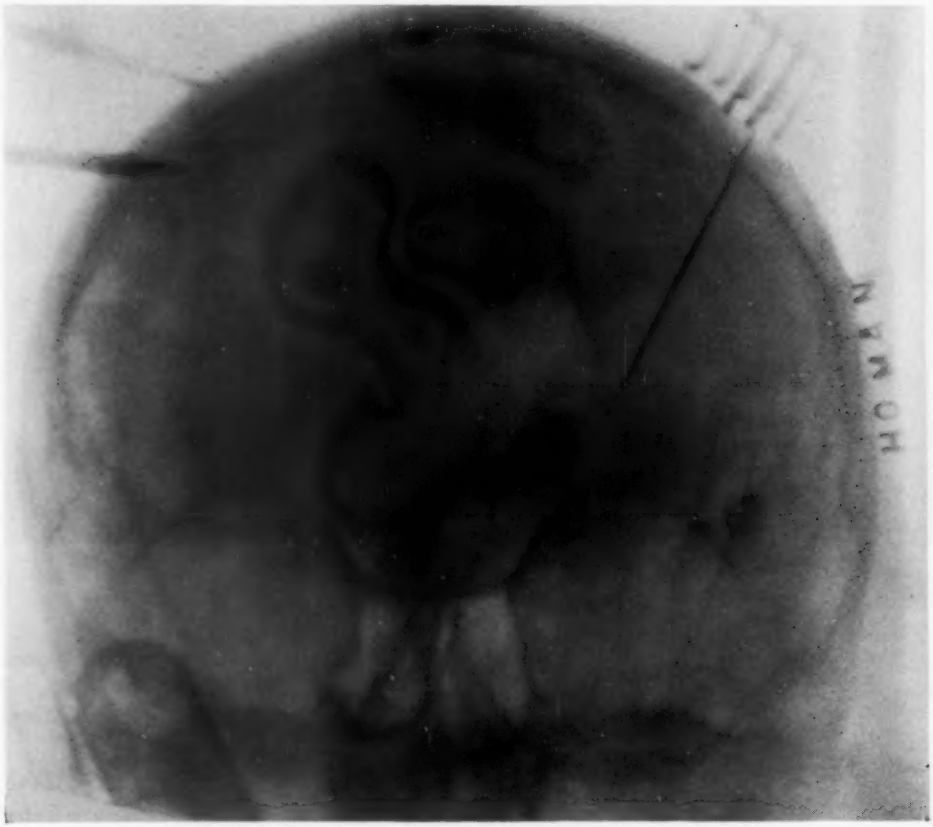


FIG. 25. Antero-posterior pneumoencephalogram made with polaroid film during the operation of chemopallidectomy. This film is developed in fifty seconds and provides the surgeon with immediate information for appraisal of the position of the brain cannula before proceeding with operation. In this case the needle was allowed to penetrate the brain for a depth of 3 centimeters. "X" indicates the point at which a correctly placed cannula should aim. Thus, it is immediately apparent to the surgeon that the cannula has been correctly placed as far as the antero-posterior plane is concerned, and that there is no need for a correction of its position in this plane.

These figures represent the roentgenographic checks which were made on the location of the cannula immediately prior to the physiologic procaine test.

Having thus determined roentgenographically that the cannula has been placed in a position which corresponds with the mesial globus pallidus, approximately 0.25 cubic centimeter of procaine is injected. Usually this will result in alleviation of contralateral tremor and rigidity. In some instances this physiologic test is followed by immediate injection of alcohol or Etopalin for infliction of a permanent lesion. However, in some cases, we have deferred the alcohol injection for twenty-four or forty-eight hours, to allow the patient to recover fully from the effects of pneumoencephalography before proceeding with the neurolytic lesion.

In any event, the cannula is fixed in its position with a firm suture around the dura and another through the galea. It is also fixed to the scalp in the manner

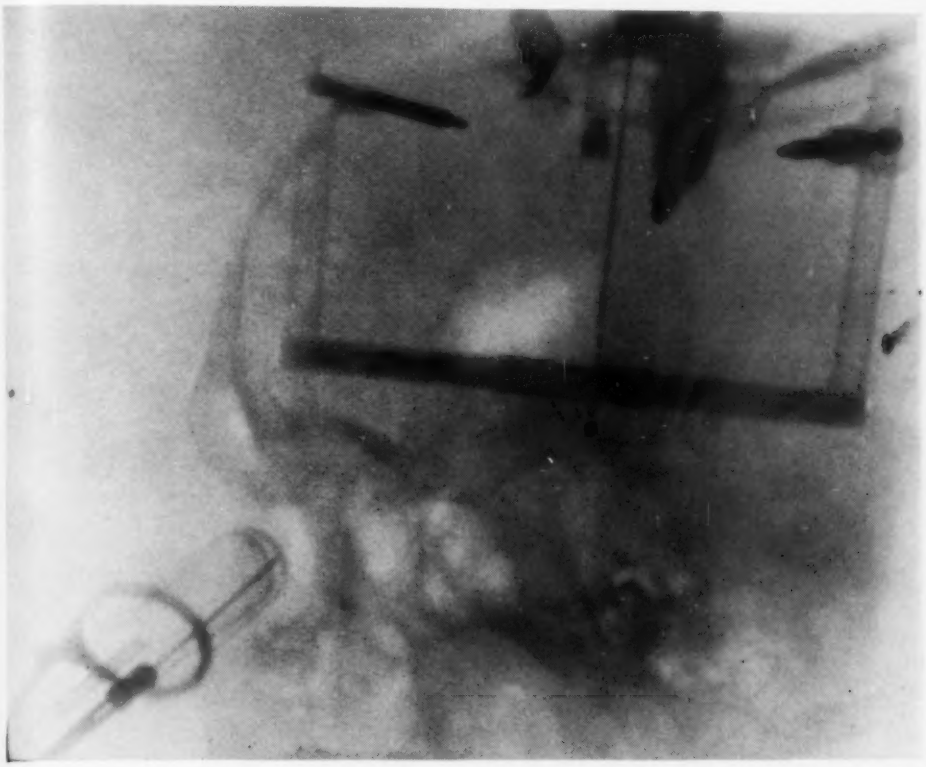


FIG. 26. Lateral pneumoencephalogram in the patient represented in Figure 25, made with polaroid x-ray film during the operation. "O" marks the site of the desired lesion in this plane, and the cannula is pointing directly towards it. Thus there is no need for correction of the cannula position. With this information the surgeon could proceed to insert the cannula to the desirable depth. Having checked with the films represented in Figures 25 and 26, the cannula was placed at a depth of 6.3 centimeters beyond the cerebral cortex. Following this step, additional films were made, as shown in subsequent figures.

indicated in Figure 29. This allows the catheter to remain in line in the brain for seven to ten days, so that gradual, permanent destruction of the mesial globus pallidus can be carried out using neurolytic agents injected into the globus pallidus. (In Figures 30 and 31 are shown antero-posterior and lateral roentgenograms representative of cannulae well placed by the convexity approach.)

The lesion

Having properly localized the tip of the polyethylene cannula within the mesial globus pallidus one then proceeds to make a destructive lesion in this region. Since this lesion, both in its localization and in its quantitative aspects, is the crux of this particular surgical technique, one must be painstaking in insuring the fact that it is properly accomplished.

In previous communications, we have discussed the various methods of producing a lesion in the globus pallidus and have stated the various reasons for our preference of the use of a chemical neurolytic agent (absolute alcohol). In

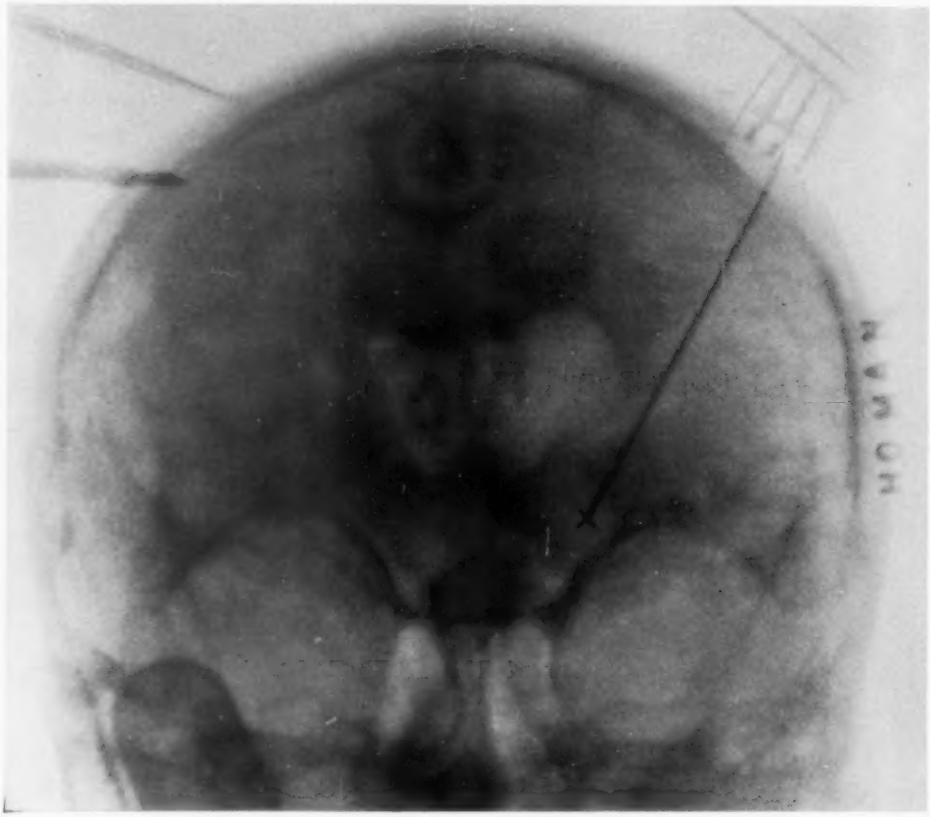


FIG. 27. Antero-posterior pneumoencephalogram showing that the cannula has reached the desired position in the mesial globus pallidus indicated by "X".

brief, after experimenting with various means, we have elected this method because we are better able to achieve a lesion of sufficient size than with electrolysis, radio-frequency or incisional methods. Moreover, it has proved to be superior for gradual control of the extent of the lesion and for increasing its size by increments according to the clinical result obtained during the injection. Finally, and most important, we prefer this method because, with its use, we have been able to obtain a high incidence of excellent relief of tremor, rigidity and other dyskinetic manifestations. The mortality rate is exceedingly low, as is the incidence of other complications. The results thus far seem to us to be better than those following any other method with the exception of anterior choroidal artery occlusion. Thus, at present we prefer to make a lesion in the globus pallidus by injection of a neurolytic agent, because it is by this means that we have been able to obtain the best results.

In the first 100 cases of chemopallidectomy we employed absolute alcohol as the neurolytic agent. In a subsequent series we employed a mixture of 8 per cent celloidin and 95 per cent ethanol (Etopalin, Ciba) which appears to have certain advantages over absolute alcohol. Although this mixture retains its neurolytic qualities, it is a viscous preparation, and the injection can be controlled more

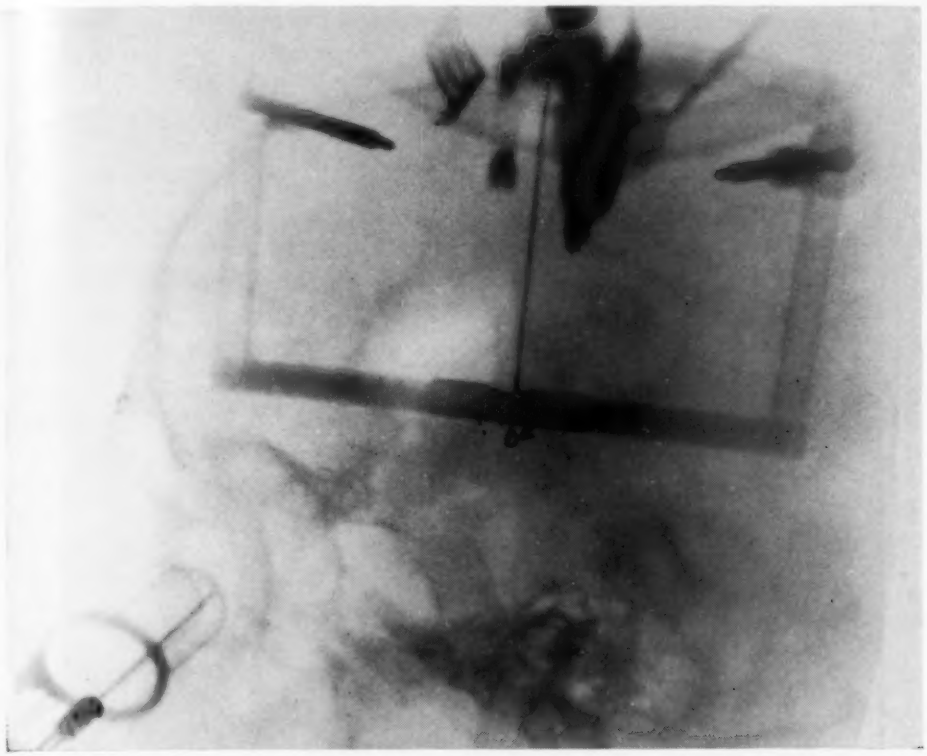


FIG. 28. Lateral pneumoencephalogram showing that the cannula has been properly placed in this plane and has reached the mesial globus pallidus as indicated by "O". Once the correct localization of the cannula has been verified by polaroid x-ray films, as represented in Figures 27 and 28, the surgeon proceeds with the procaine injection in order to obtain physiologic verification.

easily because of this viscosity. There is less danger of reflux of the medium along the needle tract and less danger of spread into adjacent areas (Fig. 32). Furthermore, the weight and bulk of the viscous material itself helps to inflict a lesion at the site of injection (Fig. 33). We have found this agent to be eminently satisfactory and it has been used in all cases of chemopallidectomy during the past year.

During our development of this technique we have experimented with various methods for injection of the neurolytic agent. It would appear that with absolute alcohol the best procedure is to inject this agent slowly, at the rate of approximately 0.5 cubic centimeter per minute. If any untoward symptoms should develop during the process, the injection should be discontinued. When using absolute alcohol, a total of 1 cubic centimeter per injection is usually required. It is best to position the head so that the alcohol has a tendency to pool at the outlet of the cannula.

When using Etopalin, 0.5 to 0.75 cubic centimeter will usually suffice to produce an adequate lesion. This quantity must be injected slowly over a period of twenty minutes. At times, the full effect of the injection may be delayed for one or two hours. Therefore, meticulous caution must be employed in the use of

FIG. 29. Bird's eye view of the scalp immediately following operation in which 2 brain cannulas were used. Note the manner in which the cannulas are fixed prior to application of a surgical head dressing. The cotton patty in the center of the scalp is attached by a silk suture to the scalp. The rubber bands placed around the cotton patty allow the brain cannulas to be held firmly in place between postoperative injections.

this substance. Provided such precautions are taken, there is very little hazard. If the convexity approach is used, injection of Etopalin should not be undertaken until the patient has been placed in a sitting position. This position permits the viscous substance to pool at the bottom of the cannula, thus inflicting the lesion at the desired point.

Two-cannula technique. From time to time, we have found it necessary to place more than one lesion in the globus pallidus in order to obtain a complete alleviation of contralateral tremor and rigidity. Therefore, in some cases in which the tip of the cannula is demonstrated to lie well within the mesial globus pallidus, but in which procaine injection has produced less than a complete alleviation of contralateral tremor and rigidity, we may insert a second cannula into the globus pallidus on the same side. If the first cannula is inserted into the anterior portion of the globus, the second is inserted approximately 1 centimeter behind it. If the first cannula has been inserted into the posterior portion of the globus, the second is inserted at approximately the level of the anterior commissura.

This technique of placing two cannulas at the same time enables us to make a sufficiently large lesion in the globus to insure satisfactory alleviation of the

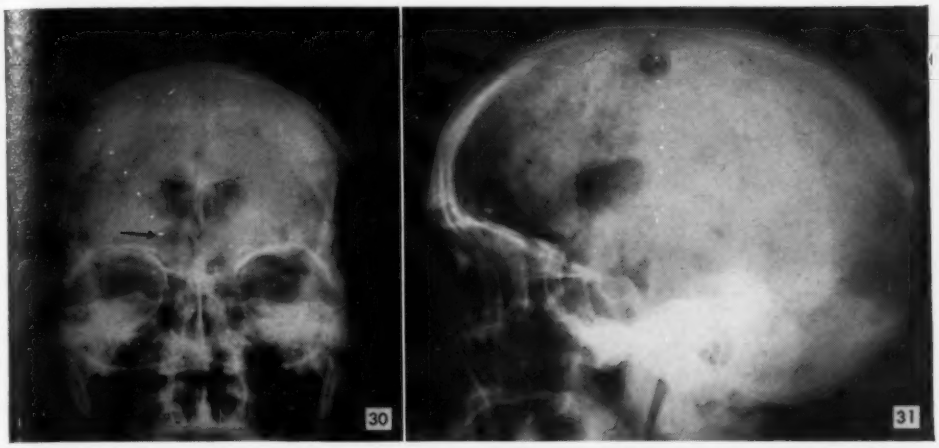


FIG. 30. Postoperative antero-posterior pneumoencephalogram showing an indwelling brain cannula introduced by the convexity approach. The radio-opaque marks on each centimeter of the polyethylene stylet demonstrate the course of the brain cannula. The site of the lesion is indicated (arrow) by a piece of silver clip which was passed through the cannula.

FIG. 31. Lateral pneumoencephalogram showing the position of the brain cannula postoperatively in a successful case of chemopallidectomy performed by the convexity approach.

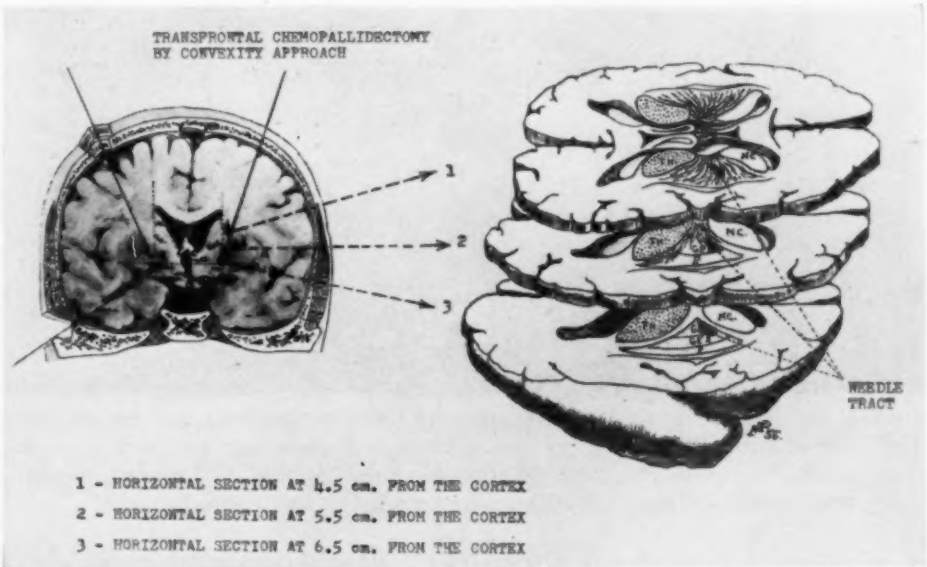

TRANSFRONTAL CHEMOPALLIDECTOMY
BY CONVEXITY APPROACH
1
2
3
NEEDLE TRACT
1 - HORIZONTAL SECTION AT 4.5 cm. FROM THE CORTEX
2 - HORIZONTAL SECTION AT 5.5 cm. FROM THE CORTEX
3 - HORIZONTAL SECTION AT 6.5 cm. FROM THE CORTEX

FIG. 32. Diagrammatic representation of the needle tract and site of the lesion in the convexity approach to the mesial globus pallidus. Note that at a distance of 4.5 centimeters beneath the cortex the needle lies in the internal capsule; at 5.5 centimeters beneath the cortex the tip of the cannula has penetrated the globus pallidus; and at 6.5 centimeters beneath the cortex the tip of the needle lies in the mesial globus pallidus in its inferior portion. Thus, an injection made before the proper depth of penetration has been reached may produce a lesion in the internal capsule or may spread into the caudate nucleus. For this reason, the injection must not be made until the tip of the cannula lies in the inferior portion of the mesial globus pallidus and this position is confirmed roentgenographically.

FIG. 33. Specimen showing the lesion produced by chemopallidectomy. In this case, the operation of chemopallidectomy via the subtemporal approach was performed in the autopsy room. The neurolytic medium (Etopalin) was colored by azocarmine dye, and 0.8 cubic centimeter produced the lesion demonstrated in this figure.

contralateral symptoms. The same end may be accomplished by performing a second operation for enlargement of the lesion if the results of the first operation are incomplete. However, it appears that one can obviate the necessity for a second operation by the use of the two-cannula technique. It has been employed by us only during the past six months. Thus far, it appears to be a useful adjunct to the procedure.

Reinjection. The procedure of chemopallidectomy as outlined in this paper has several advantages. Firstly, and most important, it is simple to perform for

surgeons who are conversant with the internal anatomy of the brain. Secondly, the preliminary procaine injection permits evaluation of the potential results of operation before proceeding with the infliction of a permanent intracerebral lesion. Thirdly, maintenance of the cannula in the intracerebral position for seven to ten days following operation permits control of the size of the lesion, which may prove necessary in a particular case—the ultimate size depending upon the results of the initial injection. For these reasons, it is applicable to older patients as well as young ones. The age range in our series was 8 to 75 years.

In the case of Etopalin, only a small quantity is injected at the time of operation (about 0.4 cubic centimeter) immediately after the results of the procaine test have confirmed correct localization of the cannula. However, in debilitated patients or in those who have withstood the preoperative pneumoencephalogram poorly, it is possible to defer injection of the agent until the day following the physiologic confirmation by procaine injection.

Generally, a second injection of Etopalin (0.5 to 0.7 cubic centimeter) is made forty-eight to seventy-two hours after the first, in order to insure production of an adequate lesion. In some instances, if the patient is somnolent or shows signs of cerebral edema, the second injection may be deferred for several days. In other patients in whom there is a major tremor, a larger lesion may be necessary, necessitating injection of up to 0.75 or 0.8 cubic centimeter of Etopalin.

In many cases, relief of tremor and rigidity persists following the second injection. In such instances, the catheter is removed from the brain somewhere between the seventh and tenth postoperative days If, however, there appears to be a tendency towards recurrence of symptoms, a third injection of Etopalin (usually in the same amount as the second injection) is given between the seventh and tenth days after operation. Generally no more than three injections are made in any individual case.

There are patients in whom an excellent result has been maintained following a single injection. However, although the number of injections and the quantity of material injected is always determined individually, we favor the use of two or three injections in order to insure adequate destruction of neural tissue and a lasting symptomatic result. A roentgenographic check should always be made immediately prior to reinjection to demonstrate that the indwelling cannula is still in the correct position.

SUMMARY

The basic principles underlying the technique of chemopallidectomy, as well as the technique itself, have been described. The steps of the operative procedure which should be mastered in order to obtain good results in the treatment of parkinsonism are: 1) *Preoperative x-ray localization of superficial landmarks*, achieved by means of pneumoencephalography. 2) *Insertion of a polyethylene cannula through a small trephine opening, by hand or with the help of a simple pallidectomy guide, into the mesial globus pallidus.* The technique for placement of the cannula is described, with particular emphasis upon the pneumoencephalographic techniques for checking its position during operation. 3) *The physiologic*

test for correct localization of the cannula, by means of intracerebral procaine injection. 4) *Gradual production of an adequate lesion in the mesial globus pallidus by injection of either absolute alcohol or Etopalin.* The number of injections and the quantities of material are discussed.

Chemopallidectomy has several advantages. These are: 1) It is based upon a method of roentgenographic localization which is simple to comprehend and can be corroborated easily in the anatomic or pathologic laboratory. 2) The surgical technique is simple and can be readily mastered by any capable neurosurgeon who is willing to pay meticulous attention to small details. 3) It may be carried out without any extraordinary instrumentation, if the catheter is inserted directly into the globus pallidus by hand. A pallidectomy guide (cannula holder), if used, is exceedingly simple and weighs only 6 ounces. With or without the aid of this instrument, the surgeon must guide the cannula into the globus pallidus. 4) By means of procaine injection it is possible to test whether or not an area has been reached, the destruction of which would result in alleviation of tremor and rigidity. This point may be accurately localized and the effects of injection corroborated clinically before the surgeon commits himself to infliction of a permanent destructive lesion. Not only does this help to insure satisfactory results but also to prevent untoward complications or sequelae. 5) Each operation can be tailored to fit the requirements of the particular patient. Since parkinsonism varies in its manifestations from patient to patient, both quantitatively and qualitatively, there is no ground for performing identical operations in all cases. The described technique of chemopallidectomy allows for the differences between patients and permits the surgeon to vary the size and site of the destructive lesion accordingly. 6) The simplicity of the surgical procedure, the use of the preoperative procaine test, and the ability to inflict a gradually destructive lesion make this particular technique applicable to older patients as well as to younger ones. It has been carried out in patients as young as 8 years of age and as old as 75 years of age. 7) Chemopallidectomy for the treatment of parkinsonism can yield consistently good results. The mortality rate is very low, as is the incidence of other complications.

REFERENCES

1. Bucy, P. C., and Case, T. J.: Tremor: physiologic mechanism and abolition by surgical means, *Arch. Neurol. & Psychiat.* **41:** 721–746, 1939.
2. Klemme, R. M.: Surgical treatment of dystonia, paralysis agitans and athetosis, *Arch. Neurol. & Psychiat.* **44:** 926, 1940.
3. Putnam, T. J.: Relief from unilateral paralysis agitans by section of the lateral pyramidal tract, *Arch. Neurol. & Psychiat.* **40:** 1049, 1938.
4. Oliver, L. C.: Parkinson's Disease and Its Surgical Treatment. London, H. K. Lewis and Co., 1953, p. 87.
5. Ebin, Judah: Surgical treatment of parkinsonism: indications and results, *Bull. New York Acad. Med.* **27:** 653–678, 1951.
6. Walker, A. E.: Cerebral pedunculotomy for the relief of involuntary movements. II. Parkinsonian tremor, *J. Nerv. & Ment. Dis.* **116:** 766–775, 1952.
7. Meyers, R.: A surgical procedure for postencephalitic tremor, with notes on the physiology of the premotor fibers, *Arch. Neurol. & Psychiat.* **44:** 455, 1940.

8. MEYERS, R.: Surgical experiments in therapy of certain "extrapyramidal" diseases: current evaluation, *Acta psychiat. et neurol.* Suppl. 67, pp. 3–42, 1951.
9. BROWDER, J.: Section of the fibers of the anterior limb of the internal capsule in parkinsonism, *Am. J. Surg.* **75:** 264–268, 1948.
10. SPIEGEL, E. A.; WYCIS, H. T., AND THUR, C.: The stereoencephalotome, *J. Neurosurg.* **8:** 452–453, 1951.
11. SPIEGEL, E. A., AND WYCIS, H. T.: Ansotomy in paralysis agitans, *Arch. Neurol. & Psychiat.* **71:** 598–614, 1954.
12. WYCIS, H. T., AND SPIEGEL, E. A.: The effect of thalamotomy and pallidotomy upon involuntary movements in chorea and athetosis, *Surg. Forum* (1950) pp. 329–332, 1951.
13. TALAIRACH, J.; PAILLAS, J. E., AND DAVID, M.: Hemiballistic type of dyskinesia treated by frontal cortectomy then by coagulation of the ansa lenticularis and internal portion of globus pallidus. Important improvement for one year, *Rev. neurol.* **83:** 440–451, 1950.
14. DAVID, M.; HECAEN, H., AND TALAIRACH, J.: Surgical treatment of dyskinesia. International Neurological Meeting, Paris, July, 1952.
15. NARABAYASHI, H., AND OKUMA, T.: Procaine oil blocking of the globus pallidus for the treatment of rigidity an tremor of parkinsonism, *Proc. Japan Acad. Med.* p. 29, 1953.
16. NARABAYASHI, H.: Procaine oil blocking of the globus pallidus for the treatment of rigidity and tremor of parkinsonism, *Psychiat. et Neurol. Japonica* **56:** 471–495, 1954.
17. NARABAYASHI, H.; OKUMA, T., AND SHIKIBA, S.: Procaine oil blocking of the globus pallidus, *A. M. A. Arch. Neurol. & Psychiat.* **75:** 36–48, 1956.
18. FENELON, F., AND THIEBAUT, F.: Results of neurosurgical treatment of parkinsonian rigidity by means of unilateral striopallidal intervention, *Rev. neurol.* **83:** 280, 1950.
19. FENELON, F.: Neurosurgical treatment of dyskinesias by a personal method: subpallidal extrapyramidotomy by electrocoagulation. Principles of the method, techniques, results and indications to surgery, *Sem. hôp. Paris* **28:** 3775–3781, 1952.
20. FENELON, F.: Neurosurgery of ansa lenticularis in dyskinesias and Parkinson's disease. Review of principles and techniques of a personal operation, *Sem. hôp. Paris* **31:** 1835–1837, 1955.
21. GUIOT, G., AND BRION, S.: Neurosurgical treatment of choreo-athetosic and parkinsonian syndromes, *Sem. hôp. Paris* **28:** 2095–2099, 1952.
22. GUIOT, G., AND BRION, S.: Treatment of abnormal movements by pallidal coagulation: technique and results, *Rev. neurol.* **89:** 578–580, 1953.
23. GUIOT, G., AND BRION, S.: Pallidal surgery in dyskinesias, *Sem. hôp. Paris* **31:** 1838–1845, 1955.
24. KLEIN, M. R.: Attempt to treat athetosis by destruction of the ansa lenticularis, *Sem. hôp. Paris* **31:** 1832–1835, 1955.
25. COOPER, I. S.: Ligation of the anterior choroidal artery for involuntary movements—parkinsonism, *Psychiat. Quart.* **27:** 317–319, 1953.
26. COOPER, I. S.: Surgical occlusion of the anterior choroidal artery in parkinsonism, *Surg., Gynec. & Obst.* **99:** 207–219, 1954.
27. COOPER, I. S.: Surgical alleviation of parkinsonism: effects of occlusion of the anterior choroidal artery, *J. Am. Geriatrics Soc.* **2:** 691–718, 1954.
28. COOPER, I. S.: Intracerebral injection of procaine into the globus pallidus in hyperkinetic disorders, *Science* **119:** 417–418, 1954.
29. COOPER, I. S.: Chemopallidectomy: an investigative technique in geriatric parkinsonians, *Science* **121:** 217–218, 1955.
30. COOPER, I. S., AND POLOUKHINE, N.: Chemopallidectomy: a neurosurgical technique useful in geriatric parkinsonians, *J. Am. Geriatrics Soc.* **3:** 839–859, 1955.
31. COOPER I. S.: The Neurosurgical Alleviation of Parkinsonism. Springfield, Ill., Charles C Thomas, Publisher, 1956.

CHEMOPALLIDECTOMY FOR DYSTONIA MUSCULORUM DEFORMANS

IRVING S. COOPER, M.D., NICOLAS POLOUKHINE, M.D.
AND THOMAS I. HOEN, M.D.

During recent years, as it has become apparent that surgery of the globus pallidus and its efferent pathways can relieve the tremor and rigidity of parkinsonism, it has also been observed that choreiform movements and other dyskinetic or hyperkinetic manifestations may be benefited by this type of operative intervention (1–3). During our investigation of the surgical treatment of parkinsonism several findings were noted which encouraged us to perform the operation of chemopallidectomy, not only in cases of parkinsonism but in a variety of disorders associated with involuntary movements. Several of our parkinsonian patients had dystonic deformities of the hands or feet which were completely reversed to a normal state following either anterior choroidal artery occlusion or chemopallidectomy. Moreover, in some of the cases of parkinsonism, particularly those of a postencephalitic nature, a mixed type of movement disorder was observed preoperatively, *i.e.*, in addition to tremor and rigidity, there were choreiform or even athetoid movements. These too, in some instances, were relieved by anterior choroidal artery occlusion or chemopallidectomy. Thus, on the basis of our own experience as well as the work of other investigators, we were encouraged to perform the operation of chemopallidectomy in various types of advanced involuntary-movement disorders.

During the past two years the operation of chemopallidectomy has been carried out in 20 children whose affliction might be placed in the broad, nonspecific category of cerebral palsy. Among these patients were children with manifestations of chorea, choreo-athetosis, tension-athetosis, and dystonia musculorum deformans. It is noteworthy that in some instances each of these manifestations has been relieved by chemopallidectomy. The only difference between the operation of chemopallidectomy as performed for the latter disorders and that performed for parkinsonian tremor and rigidity, is that in the case of the grosser involuntary movements such as choreo-athetosis or dystonia, the lesion must be placed in the posterior portion of the globus pallidus as it lies adjacent to the posterior limbs of the internal capsule. In cases of parkinsonian tremor and rigidity, the site of the lesion within the globus may be anywhere within its anterior and posterior limits.

For the purpose of this report we have selected 1 patient from our series of 20 children with disorders of involuntary movement for presentation. This selection was made for the following reasons: 1) The patient, although her disease was classified as dystonia musculorum deformans, had in addition violent movement disorders of the choreiform and athetotic type admixed with severe dystonic manifestations. 2) The case is one of the few in our series in which simultaneous bilateral chemopallidectomy was performed. 3) The relief of all involuntary choreiform, athetotic and dystonic abnormalities in this patient

by the simple procedure of chemopallidectomy has been remarkable. 4) Although the eventual long-range therapeutic result remains to be seen, the basic implications of the fact that chemopallidectomy relieved all these varying abnormal dystonic manifestations seem to us to deserve the attention of those concerned with similar problems. This case illustrates the results of our current investigation into the use of chemopallidectomy in all of the so-called extrapyramidal or hyperkinetic syndromes. A report of a more detailed nature regarding our total experience with these disorders in children will be forthcoming in the near future.

CASE REPORT

S.W., a 12-year old girl, was referred for neurosurgical consultation on December 5, 1955. The patient and her parents stated that she had been well until the age of 8, at which time involuntary twitching motions of the left hand were noted. About the same time it was observed that the left hand had a tendency to remain closed in a fist-like position. This difficulty became gradually more marked, and about one year after onset there was similar involvement of the left lower extremity; the left foot curled inwards and there were involuntary movements of a gross nature in the entire left lower extremity. During subsequent months, these involuntary choreic-type manifestations involved all four extremities. The movements were noted at all hours of the day, but subsided during sleep. They gradually involved the nuchal musculature, and dystonic, writhing movements of the trunk developed.

In 1953, a definite diagnosis of dystonia musculorum deformans was made and during that year the diagnosis was confirmed at three different neurologic clinics. Although there were occasional remissions during which the involuntary movements and dystonic posture of the extremities, neck and trunk were not as severe, there was generally a steady progression of symptoms during the ensuing years.

In January 1955, the movements and dystonic posture were so severe that the patient was forced to discontinue her attendance at school. Subsequently, progression of the disease was rapid and she became completely incapacitated and disabled. As a result of difficulty in feeding, her weight fell from a normal 110 pounds to 80 pounds. She was confined to a wheelchair and required some help in feeding and dressing herself.

At the time of consultation in December 1955, it was decided that the patient would be followed clinically before a decision was made regarding the advisability of neurosurgical intervention. However, progression of the disease was relentless and when she was seen again in February 1956, she was markedly worse. Movements of all four extremities were constant and violent. Heavy sedation was necessary in order to provide any degree of rest for the patient and for those taking care of her. Feeding, dressing, locomotion and toilet habits required major assistance at all times. She had to be tied into a wheelchair or onto her bed to avoid being thrown to the floor.

Because of the desperate nature of symptoms at that time, operation was decided upon, and bilateral chemopallidectomy was performed February 25, 1956. The violent nature of the movements necessitated general anesthesia. Catheters were inserted into the right and into the left globus pallidus by the convexity approach. At this time, before closure of the wounds, the patient was allowed to awaken so that the dystonic movements once again became evident. Procaine was injected into the pallidum on each side, and it was noted that the involuntary movements were relieved but that motor power was maintained. Etopalin[1] (0.4 cubic centimeter) was injected on each side before closure of the wounds.

The patient had an uneventful convalescence. The day following operation she was alert and fully oriented. Involuntary movements were absent from all four extremities and she was able to feed herself and perform useful voluntary acts without difficulty. The only

[1] An 8 per cent solution of specially prepared cellulose in 95 per cent ethyl alcohol (Ciba).

abnormal finding was an intermittent Babinski sign on the left. On the fourth postoperative day, 0.3 cubic centimeter of Etopalin was injected on each side and the catheters were removed. The patient was out of bed on the fifth postoperative day and able to sit in a chair without assistance and without the development of any involuntary movements. The dystonic inversion of both feet had been relieved considerably, but not completely. There was still some spasmodic twitching of the erector spinae muscles of the back.

The patient walked without assistance on the seventh postoperative day. She was discharged from the hospital on the thirteenth postoperative day. Since the time of hospital discharge she has continued to show signs of improvement. The dystonic deformities of the feet gradually reversed themselves completely and the gait became normal. She is now able to ride her bike, walk, run and dance. Involuntary movements of the extremities are no longer present, although there is still some twitching of the erector spinae muscles. The marked difference between the preoperative disabling state of involuntary hyperkinesis and the postoperative freedom from abnormal movements and disability may be seen in Figures 1, 2 and 3.

COMMENT

It is necessary to be very circumspect regarding the future course of this patient and of others who have had similar results from chemopallidectomy.

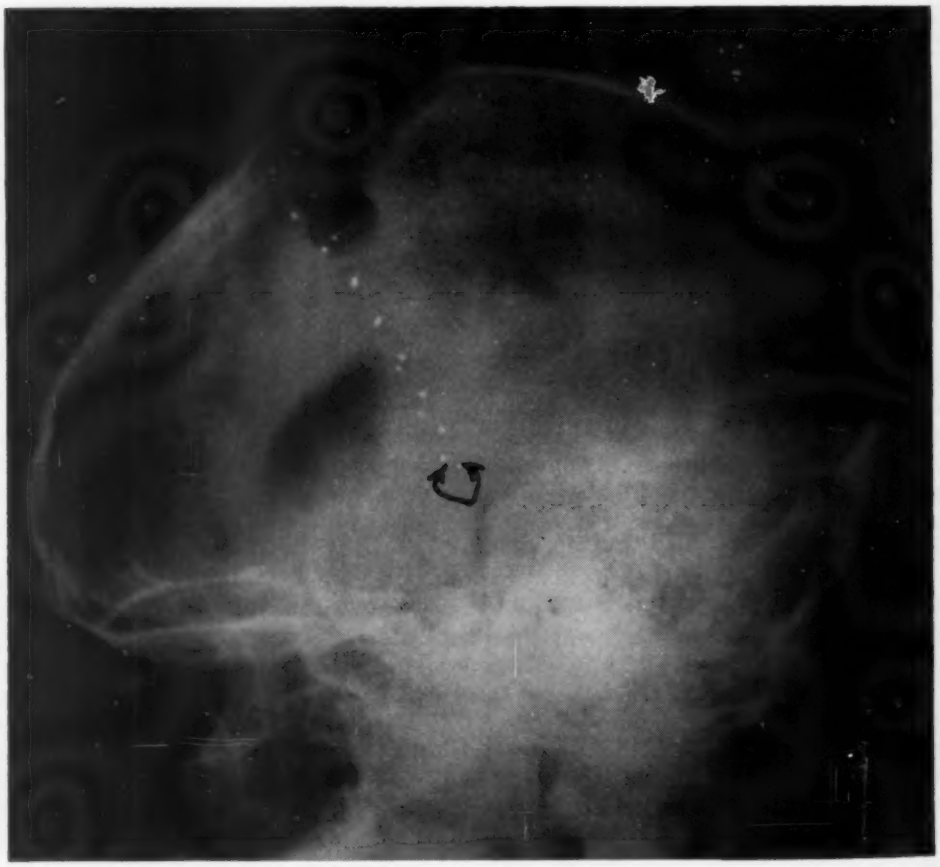


FIG. 1. Lateral pneumoencephalogram showing position of two cannulas which have been inserted into the right and left globus pallidus, respectively, by the convexity approach. Both procedures were performed at the same operation.

FIG. 2. Patient S.W. Photographs taken from preoperative motion picture film showing constant involuntary movements. During the six months prior to surgery these movements stopped only following heavy sedation or during sleep.

FIG. 3. Patient S.W. Segments from motion picture film made two months post operatively, demonstrating freedom from involuntary movements as a result of bilateral chemopallidectomy.

Although up to this time she has been relieved of her severe preoperative hyperkinetic and dystonic manifestations, no one can state whether or not these symptoms will recur in the future. Several patients in the juvenile series have been relieved of hyperkineses and dystonia for eighteen months and longer. However, the long-range results remain for future evaluation.

This report is intended to serve as a further contribution to a physiologic understanding of disorders of involuntary movement and dystonia. The results in the patient presented here lead us to conclude that the globus pallidus is part of the mechanism involved not only in tremor and rigidity but also in such gross movements as those seen in chorea, athetosis, and dystonia musculorum deformans.What part the globus may play and under what circumstances, cannot be elucidated at this time.

SUMMARY

The operation of chemopallidectomy has been undertaken in 20 children having disorders of involuntary movement. In certain cases, the diverse hyperkinetic syndromes of chorea, athetosis and dystonia have been relieved by this operation. One case of bilateral chemopallidectomy for dystonia musculorum deformans has been reported in detail.

REFERENCES

1. MEYERS, R.: Surgical experiments in therapy of certain "extrapyramidal" diseases: current evaluation, *Acta psychiat. et neurol.* Suppl. 67, pp. 1–42, 1951.
2. WYCIS, H. T., AND SPIEGEL, E. A.: The effect of thalamotomy and pallidotomy upon involuntary movements in chorea and athetosis, *Surg. Forum* (1950) 329–331, 1951.
3. COOPER, I. S.: Surgical occlusion of the anterior choroidal artery in parkinsonism, *Surg., Gynec. & Obst.* **99:** 207–219, 1954.

CRITERIA IN THE SELECTION OF PARKINSONIAN PATIENTS FOR CHEMOPALLIDECTOMY

DAVID FAIRMAN, M.D. AND IRVING S. COOPER, M.D.

In the selection of parkinsonian patients for chemopallidectomy, a few criteria deserve special consideration, in addition to the principles applied to any elective surgical procedure. It is the purpose of this paper to emphasize these particular criteria.

Patients affected with the parkinsonian syndrome present many other problems besides the neurologic symptoms. Although hyperkinetic manifestations or tremor may be predominant, the patients are frequently under continuous emotional stress. They are cognizant of their condition, trying always to conceal it because they are ashamed of their illness. They isolate themselves, and try to diminish their social relationships as much as possible. Any common event of daily life may upset them, making the tremor more apparent. In their efforts to conceal it they become more nervous, thus causing a vicious circle very difficult to control.

When rigidity is the predominant symptom, impairment of function is the outstanding result. The parkinsonian patient watches the gradual progression of the rigidity as it affects first one extremity and then the other on the same side and then the extremities on the other side, realizing every day his lessening capacity for performing the activities of his daily life. It is easy to understand his vital preoccupation with the impairment of function.

It should be emphasized that the victims of parkinsonian suffer in many different ways. The suffering engendered by continuous and violent tremor is different from that associated with a bilateral rigidity which is causing serious disability. Some patients are mainly disturbed by other features of the disease, such as loss of speech or oculogyric crises.

The foregoing facts are mentioned for the purpose of stressing the principle that *alleviation of tremor and rigidity is actually only alleviation of certain symptoms and not of the syndrome as a whole.* The aim of chemopallidectomy in the treatment of parkinsonism is the relief of the suffering and incapacitation of the patient by means of the relief of tremor and rigidity and certain related abnormalities. Often, however, tremor or rigidity are not the principal complaints, and such relief will not provide what the patient actually desires.

Thus, we cannot select our patients having in mind only the possibilities as far as the rigidity and tremor are concerned. Even if alleviation of symptoms is obtained, the main purpose of the operation has not been fulfilled if the patient is not relieved of his suffering and does not have some degree of satisfaction.

PLAN OF STUDY

In order to accomplish this aim — relieving the patient as well as his symptoms — we have gradually developed a routine, as follows: The patient is first

examined by one of us in order to obtain a panoramic view of the neurologic condition and the general attitude of the patient and his relatives.

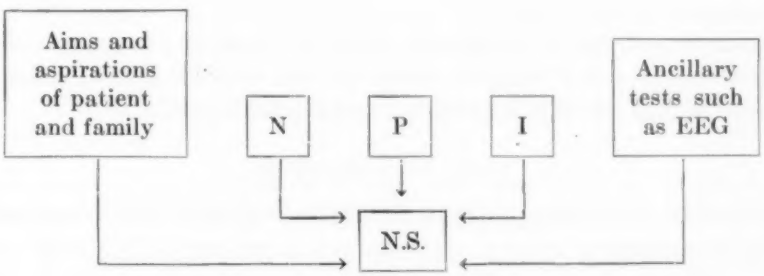
If, on the basis of the neurologic examination, the patient is tentatively considered to be a suitable candidate for surgery, the problem is discussed with the patient and relatives. For this purpose, a special point is made of furnishing all the facts about the operation — the actual surgical procedure, the expected benefits to the patient, and the risk involved. We stress the fact that an operation performed on one side of the brain alleviates only the tremor and rigidity of the extremities on the opposite side, and usually not on the ipsilateral side. If the symptoms are bilateral, the patient will be helped according to the degree of functional capacity of the benefited side. However, if the syndrome is unilateral, he may expect practically complete functional recuperation if the operation is successful.

As far as the risks are concerned, we systematically refer to our statistical figures based on the current series of 245 cases of chemopallidectomy. The mortality rate has been 3 per cent and the risk of hemiplegia (hemorrhage or cerebral infarction) has been between 2 and 3 per cent.

When no formal contraindications have been noted during this first examination, we advise the chemopallidectomy providing the final results of complete studies to which the patient is submitted when he enters the hospital confirm our first impression.

Upon admission to the hospital, a complete neurologic examination including electroencephalography, electromyography, a series of psychologic tests and a physical examination are performed before the final decision concerning surgery is reached. Much of this has been outlined in a preceding report.

The following is a graphic representation of how the selection of patients should be handled:



This means that the final decision for or against surgery should be reached by the neurosurgeon (N.S.) only after he has obtained all the information from the members of the team, which is composed of the neurologist (N), the psychologist (P) and the internist (I), and after he has integrated this information with the aims and aspirations of the patient and relatives. All of these factors play very important roles. It is particularly important to ascertain exactly *what the patient is seeking*, before making a final recommendation.

INDICATIONS AND CONTRAINDICATIONS

Certain patients should be excluded as potential surgical candidates, because of:

1. *Symptoms of pseudo-bulbar palsy*, such as dysphagia and dysphonia. Phonation and articulation difficulties may reflect only the stiffness and weakness of the pharyngeal musculature and vocal cords. On the other hand, in long-standing cases or in patients of the older age groups, pseudo-bulbar palsy may accompany parkinsonian symptoms.

2. *Respiratory difficulties* in the form of uncontrollable over-breathing, as well as vegetative phenomena such as spontaneous hyperthermia and excessive sweating. In such cases, postoperative complications are difficult to control and this would be the main reason for ruling out the operation. If performed, it should be realized that the potential risk is greater than usual.

3. *Mental deterioration*, which is usually accompanied by some degree of confusion or by extreme apathy. Apathy is often seen in cases with marked akinetic symptoms. In such circumstances, even if there could be relief of rigidity or tremor, the operation is contraindicated because the patient does not have the capacity to utilize the improvement. Moreover, patients whose marked akinetic symptoms are not related to rigidity probably will not benefit from surgery.

4. *Psychiatric disturbances*, which in many instances play an important role in the course of the illness. Excessive anxiety, paranoid manifestations with fixed delusions and obsessive compulsive psychoneurosis may be so severe as to make surgery for the relief of tremor and rigidity unwarranted. In such cases, the operation is contraindicated. Moderate to severe depression is the most frequent psychopathologic symptom observed in parkinsonian patients but, of itself, is not a contraindication. However, when it is accompanied by negativism and personality deterioration, and the severity of all of the symptoms is pronounced, operation should be ruled out.

5. *Physiologic old age*. Chronologic advanced age is no contraindication to chemopallidectomy, but when physiologically the patient shows a marked degree of deterioration and senility, operation is contraindicated.

CASE ILLUSTRATIONS

The following brief case reports illustrate some of the foregoing contraindications to surgery:

Case 1. J.B., a 58-year-old obese woman, began to have some stiffness in her left upper extremity two and a half years previously. After that, some tremor developed on the same side. Gradually, the rigidity and tremor involved both upper and lower extremities bilaterally. Two years before entry she noticed some impairment of speech, which had been gradually getting worse and had reached the status of almost complete dysarthria. The hypertonic symptoms progressed more rapidly than the hyperkinesia, so that at the time of admission she had bilateral rigidity and was completely incapacitated with severe dysphagia.

She was unable to dress herself or walk even a few steps without help, and could not carry out any of the activities of daily living alone. She had great difficulty in even feeding herself.

Parts of the Wechsler-Bellevue intelligence scale were used in a psychologic test. The results revealed a woman functioning markedly below her former basic capacities. She had severe impairment of memory, attention, concentration and abstract thinking and was not in good contact with her environment. Much of her impairment appeared to be due to a mild or moderate organic mental syndrome.

In summary, this woman presented a marked akinetic hypertonic syndrome, severe dysphagia and dysarthria, definite vegetative features, obesity and mental deterioration. In our opinion she would not be capable of utilizing the benefits of chemopallidectomy, even if the operation were successful. In addition, she was considered a poor surgical risk because of her obesity and generally poor health. Therefore, operation was not advised and patient was discharged.

Case 2. R.P.C. was a 68-year-old white male whose presenting illness started around 1940 after a period of mental depression. The onset was manifested by a progressive heaviness in the right arm with a loss of natural swinging. Next, the movements performed with the right arm became less precise. Two years after the first symptom, the right leg was affected by the same feeling of heaviness and the patient began dragging the right foot. Bradykinesia appeared and writing was steadily impaired. Speech was affected too, and bradyphemia was noticed around 1943. Rigidity appeared and spread insidiously on the left side. Then rest-tremor became apparent in the right upper limb.

Slow progression of these bilateral symptoms took place, and there was a tendency to dorsocervical kyphosis with right antero-lateral tilting. In 1947, the deformities due to rigidity (such as dorsocervical kyphosis, hand-writing position, and overbent posture) caused a practically chair-ridden condition. The clinical diagnosis at that time was Parkinson's disease with advanced cerebro-arteriosclerosis.

A marked speech deficit developed. Because of the patient's severe speech involvement, no formal psychologic testing could be performed. However, he was observed on several occasions during his stay at the hospital, and there were indications that on occasion he was poorly oriented, especially in regard to place and person. At times during the interviews, he appeared to be somewhat confused and did not comprehend what was asked of him. Answers which could be understood were unrelated to the examiners' questions. The patient had marked impairment of memory and difficulty in attention and concentration. At times he had hallucinations and severe intellectual and perceptual confusion. Thus, it would appear that there was marked involvement in both intellectual and personality areas, probably on a senile or arteriosclerotic basis. Because of the severe speech difficulties, only brief evaluation was possible. However, because of the apparent deterioration in all areas of the patient's functioning, it was felt that he would have much difficulty in withstanding the stress of operation or in utilizing any benefits therefrom. Surgery was not recommended.

Because of the standardization of the procedure and the rather low risk involved, the operation can be advised in any parkinsonian patient with either unilateral or bilateral symptoms, providing 1) the condition is progressive, 2) medical treatment has not helped the patient significantly, 3) the degree of involvement is marked enough to justify the procedure, and 4) there are no obvious contraindications. However, even the low risk of chemopallidectomy is not warranted if the patient is still functioning at his normal level.

The patient with the unilateral symptoms is theoretically the ideal candidate, but it is especially in this type of case that we have to evaluate very carefully the degree of progression of the symptoms and the extent to which the disease has impaired working or functional capacity, before deciding upon surgery. The following case is an example:

Case 3. R.S., a 49-year-old right-handed white male began having a painful sensation five years previously, localized in his right shoulder. This condition was diagnosed and treated as bursitis. There was some improvement, but the pain in his right shoulder persisted with varying degrees of intensity. Two years later he noticed tightness of the muscles of his right upper extremity and some intermittent tremor. He also felt some rigidity in his right lower leg and began dragging it when walking. For two years the progression of symptoms had been very slow and he was still able to work with some difficulty.

A psychologic test was administered to the patient. The results revealed a moderately productive individual, having marked underlying feelings of tension and aggression, of which he was apparently unaware. He had an active and, at times, productive fantasy life, from which he was able to gain some satisfaction. However, his distinct feelings of tension make it difficult for him to enjoy satisfying impersonal relationships. At times he would project his feeling of aggression on to the environment, and thus perceive others as hostile. However, the patient's ego structure appeared to be of a well developed and mature nature, so that he was basically capable of identifying with and empathizing with others. Great concern with his own difficulties prevented him, however, from seeking out relationships with those about him. The patient's reality contact generally was adequate and he was capable of dealing with most familiar and commonplace situations. He appeared to be of at least average intelligence, and his thinking generally was adequately organized and integrated.

In view of the fact that the progression of the symptoms in this 49-year-old man had been rather slow and that he was able to work and take care of all his daily activities in spite of rigidity localized in the upper and lower extremities of the right side, it was decided to defer chemopallidectomy until progression of the symptoms would justify operation. The patient was discharged to be followed at three-month intervals. Surgery was not recommended at that time.

SUMMARY AND CONCLUSIONS

Special criteria in the selection of parkinsonian patients for chemopallidectomy have been discussed. Parkinson's disease may cause patients to suffer in many different ways. The aim of the present surgical procedure is to relieve this suffering through alleviation of rigidity and tremor. It is essential, therefore, that the operation, in order to be successful, should not only relieve the rigidity and tremor but also furnish the patient with the help needed to overcome incapacitation.

The neurosurgeon should decide for or against operation only after weighing the information provided by each member of the evaluating team composed of the neurologist, psychologist, internist, physiatrist, the patient, and his relatives. The most important general contraindications are pseudo-bulbar symptoms, mental deterioration, vegetative signs, and psychiatric disorders. Physiologic signs of senility also contraindicate surgery, but chronologic aging, of itself, does not.

Parkinsonian patients with unilateral or bilateral symptoms and none of the foregoing contraindications are potentially good candidates for chemopallidectomy, provided definite progression of the disease, failure of medical therapy, and a marked degree of involvement justify this course of action.

POSTOPERATIVE MEDICAL EVALUATION OF 26 SELECTED PATIENTS WITH PARKINSON'S DISEASE

ALBERT C. ENGLAND, JR., M.D. AND ROBERT S. SCHWAB, M.D.

INTRODUCTION

In the past fifteen years there have been numerous reports in the world's medical literature on the success of a variety of surgical procedures for Parkinson's disease that have not stood the test of time. Consequently a strong skepticism has developed in the minds of many neurologists and internists about the value of surgical intervention in this disease. It seemed worthwhile, therefore, to have an outside evaluation of the results of Dr. Irving Cooper's technique—both anterior choroidal artery ligation and chemical pallidectomy with alcohol. A comparable situation is the independent survey of the results of thymectomies performed by Geoffrey Keynes in London. This survey was made by an outside neurologist, Dr. Donald Ross, in order to establish the validity of this procedure and to counteract the skeptical criticism of some clinicians.

PROCEDURE

Arrangements were made with the staff of the St. Barnabas Hospital, New York, to have patients who had undergone one of the surgical procedures return for follow-up examination in pairs. The authors visited New York at that time, spending the entire day in the evaluation of the condition of the patients. Each subject was examined independently by each of us, and neurologic and medical data were scored on a quantitative basis which will be described later in this communication. The results are summarized in this report, which covers the first 26 patients examined by us.

GENERAL CONSIDERATIONS

Before describing the technique of examination or the form of case history, the following somewhat glib explanations for claimed success in the surgical treatment of Parkinson's disease should be emphasized:

1. Improvement following surgery is due to better medical regulation of the symptoms of tremor and rigidity while in the hospital.
2. Improvement following surgery is due to strong suggestion and the influence of the surgeon's personality on the patient.
3. The general nonspecific metabolic shock of any surgical procedure in altering autonomic responses would benefit the patient.
4. The symptoms of Parkinson's disease vary from hour to hour and day to day; this would account for the improvement claimed following the surgical intervention.
5. Rest in a hospital, freedom from the stresses of home and business, careful nursing and physiotherapy, add up to a betterment that is not due to the surgery itself.

In analyzing our study of these 26 patients we shall endeavor to show that none of these five explanations can be utilized to interpret the degree of improvement that we observed.

It was hoped that our evaluation of these 26 patients would answer definitively the following questions:

1. Is it possible, by making a lesion in the globus pallidus—either tying off the anterior choroidal artery or injecting alcohol into the globus—to reduce significantly the tremor and rigidity on the contralateral side *without* inducing motor paresis or impairment?

2. If the operation is successful, will the result persist for a significant length of time, *i.e.*, months to years? Is the benefit really worth something to the patient, and not a transient affair?

3. Does this procedure replace parkinsonian rigidity and tremor with some other form of deficit in the nervous system such as dementia, personality change, epilepsy or abnormal movements of another type?

4. Following this operation, is there evidence that the patient is better able to perform his daily chores, take better care of himself, lead a more satisfactory and comfortable existence and, in some cases, reduce the amount of medicine that he had to take with the necessity of tolerating some disagreeable side-effects?

5. Is this procedure successful in a sufficiently high percentage of cases with a reasonably low percentage of complications or deaths, so that it can be recommended in good faith to suitable patients?

6. Is there any information from the study of this group of cases that will lead to better selection of patients for surgical intervention in the future?

It is obvious that in the follow-up evaluation of pre-selected cases, the emphasis inevitably is on the successful results. Patients who have died, who have had complications or who have experienced no improvement do not come back for follow-up examination. Therefore, we cannot draw any conclusions about the percentage of successful results, the incidence of complications or the risk of fatality from such a study alone. Approximately 150 patients underwent this particular operation in this hospital, so that the follow-up study was limited by this method of selection to only 20 per cent of the total group.

In addition, however, to the 26 patients in this series there were 17 who had been referred to Dr. Cooper by one of the authors (R.S.S.). These 17 patients, who had undergone 19 operations, were from a private series whom R.S.S. had carefully studied over many years. This group, in general, represented medical failures and were more seriously handicapped than the patients who are referred from general practitioners to a neurosurgeon. Among these 17 patients referred to Dr. Cooper there were 7 who, for various reasons, were deemed not suitable for surgery, so no operation was performed.

METHOD OF EXAMINATION

The hospital record and laboratory findings were available to each of us for the examination of the patient on our arrival at St. Barnabas Hospital. Usually some relatives were present during the examination, which was conducted by

each of us for periods of one to two hours in such a way that the patient was subjected to the procedure for no more than three hours. A separate neurologic history and examination was carried out.

Subjective. Next, two special forms were carefully filled in by each of us. The first form consisted of 10 questions concerning the subjective performance of the patient before the operation with respect to various categories in his environment, as shown in Figure 1. The patient was told to estimate on a percentage basis how much he was handicapped by his parkinsonism prior to the operation, with respect to performance in these 10 categories; and relatives, when present,

FIGURE 1

Parkinsonism Clinic
Massachusetts General Hospital

Patient's Evaluation (*Subjective*) Name: *Patient #5* Number: Date: *Nov. 7, 1955*

Instructions:

This sheet is designed for self-grading of your condition in the following ten ways. Please enter under each a number from zero to ten. Zero is no ability whatsoever; ten is normal before you were taken ill.

	Grade 0 to 10	
	Preop.	*Postop.*
1. Dressing, undressing, handling of snaps, buttons, laces, neckties, garters, et cetera	*2*	*5*
2. Toiletry, shaving, washing, hair-dressing, urination, defecation	*2*	*5*
3. Resting, sleeping, lying quietly, reclining, napping, degree of insomnia, dreaming, et cetera	*8*	*8*
4. Eating, using spoons, forks, knives, glasses, liquids, solids, spillage, swallowing, salivation	*3*	*7*
5. Outdoor activities, walking, running, games, swimming, walking on ice, propulsion, falling	*4*	*8*
6. Social activities, degree of social relaxation, maintenance of friendly associations, use of alcohol, use of movie and play theaters, et cetera	*4*	*7*
7. Travel. Use of automobiles, busses. Driving oneself. Trains and planes. Entering and leaving vehicles	*4*	*7*
8. Indoor activities, sitting, rising from chairs, use of tobacco, use of stairs, writing, reading, cards	*4*	*7*
9. Occupation. Extent of normal vocational activity held. Extent of ability with hobbies and recreation. Emotional attitudes towards work	*0*	*3*
10. Morale, in general. Depression? Withdrawal? Amount of satisfaction in living?	*2*	*7*
Totals	*34*	*64*

Special Comment: *Column #1—estimate 1954, preoperative*
Column #2—estimate on day of examination

Current Drug Therapy: *None*

were asked to assist in this evaluation. For example, in a patient with unilateral rigidity and tremor of the left hand and leg there might be only a 20 per cent drop in efficiency in putting on most of the clothing, but a 50 per cent drop in tying a necktie or a 60 per cent drop in tying shoe laces. We tried to integrate the over-all picture of a patient's total ability to get his clothes on and off, in relation to effort and time, and compare it with the pre-parkinsonian normal ability, which would be graded as 100 per cent. In the example cited, the integration would be something like 65 per cent of normal. Therefore the value 6.5 was put in the first scoring space on the form. The rest of the items were scored according to the findings; when added up, an average percentage of ability could be estimated. Since we did this separately, agreement between the two scores was essential for reliability. The percentage of agreement was very high, the variations being no more than 5 per cent.

After the subjective preoperative evaluation was made we went through the same 10 items and obtained scores for the postoperative levels, at the time of the examination. In more than half of the patients we tried to obtain a subjective account for an intermediate score shortly after the surgical procedure was finished to see if there was a change in either direction. This was particularly informative in patients with unilateral symptoms who had been greatly relieved of tremor and rigidity immediately after the operation, and had had a very high score for perhaps one year; then, with the beginning of trouble in the other extremity, had become partially handicapped again..

Objective. The objective examination was also composed of 10 parts and scored from 0 to 10 (10 being normal). Since the patients were all postoperative, objective preoperative scores were lacking. We tried on two occasions to estimate such scores from preoperative motion picture films and from the clinical records, and found that the results were approximately correct. These are not included in this report because they do not represent our own examinations. The items in the objective evaluation are shown in Figure 2. As in the subjective scoring, the values listed by the two examiners agreed in 95 per cent of the cases.

In general, the subjective and objective postoperative evaluations corresponded closely. Thus we might assume that had an objective preoperative score been possible, it would correspond with the subjective preoperative score. In any event, the average of the subjective and objective scores provided a fair approximation of the patient's total ability to get along, and a summary of his deficits.

After the scores were tabulated the two of us compared our notes without making changes, in order to reach the final combined conclusion of our survey. In this we used a 5-point alphabetical scale for the final postoperative score: A) was an excellent first-class result with at least 90 per cent reduction in rigidity and tremor on the contralateral side and significant betterment in performance in motor tests of all types. If the tremor and rigidity were bilateral, an A score could still be obtained on the basis of 90 per cent reduction in the contralateral tremor and rigidity on one side even though the symptoms persisted on the homolateral side. Such patients usually had considerable improvement in their motor ability.

FIGURE 2

Parkinsonism Clinic
Massachusetts General Hospital

Physician's Evaluation (*Objective*) Name: *Patient #5* Number: Date: *Nov. 7, 1955*

Instructions: Please estimate conditions under each rubric from zero (nil) to ten (normal) state. Sub-sections in the middle may be treated similarly. The right hand space is for an average grade.

Grades 0 to 10

1. Stationary: Standing: Sitting: Blinks: *bending posture; poor blinking.* Stationary: *3*
   Expression: *None* Salivation: *None*
2. Locomotion: On level: On stairs: *peculiar gait; drags left foot* Locomotion: *5*
   Timed run: Assoc. movements:
   Propulsion: Into chairs: *en bloc* Out of chairs: *fair*
3. Speech: Rate Clarity Volume (db) Speech: *8*
   Conversation *sl. fast* *mod. slurred* *sl. diminished*
   Reading: *good* *good* *low*
   Singing:
4. Rigidity: Neck Arm Wrist Knee Ankle Right Rigidity: *8*
   (right) *2+* *1+* *0* *0* *0*
5. Rigidity: Neck Arm Wrist Knee Ankle Left Rigidity: *4*
   (left) *2+* *3+* *3+* *1+* *1ø*
6. Tremor: Head Tongue Jaw Arm Hand Fingers Leg Foot
   (right) *none* Right Tremor: *10*
7. Tremor: Head Tongue Jaw Arm Hand Fingers Leg Foot
   (left) *2+* *2+* *2+* Left Tremor: *6*
8. Manipulation: Ergogram Dynamometer Manipulation: *3*
   (right) *180 rt./10 left*
   (left)
   Signature: 10 Circles: Combined:
   see chart *3+ fair* *not done*
9. General Health: Nutrition: General Health: *10*
   Medical Diseases: *none* Weight: *obese* BP: *normal*
   ECG: *not done* Blood count: *normal* Edema: *none*
   Chest X-Ray: *negative* Sleep: *good* Appetite: *good*
   Urination: *normal* Bowels: *normal* Metabolism: *not done*
10. Psychiatric: Morale:? *low* Depression: *some* Psychiatric: *6*
    Extroversion: *poor* Interests: *few*
    Activities: *few* Personality type: *Total: 63*

Still at home, largely an invalid, though he can perform essential activities himself.

However, in general, A's were not as common in the bilateral cases as in the unilateral. B) was a very good result, with generalized improvement and reduction in tremor and rigidity to between 60 and 90 per cent of what it was before operation. C) was the type of case in which the patient was somewhat better, the subjective improvement being between 25 and 60 per cent, with reduction in tremor and rigidity. D) represented patients who survived but were not affected by the operation or were made worse because of hemorrhage or other complica-

TABLE 1

Surgical Treatment of Parkinson's Disease

Patients 1 through 7 underwent unilateral choroidal ligation. Patients 8 through 11 underwent choroidal lateral ligation on one side, and alcohol pallidectomy later on the other side.

Patient No.	Sex	Age at Op.	Duration of Disease (Yrs.)		Score (Subjective)		Score (Objective)	Final Evaluation
			Preop.	Postop.	Preop.	Postop.	Postop.	
1	M	51	4	1.3	62	72	86	B
2	M	50	3	1.5	60	53	83	C
3	M	44	25	2.0	69	99	86	B
4	M	42	3	1.5	36	60	73	B
5	M	41	6	1.1	34	64	63	B
6	M	58	36	2.3	20	60	58	B
7	M	36	18	2.7	21	83	77	B
8	M	40	25	1.5	9	41	54	C
9	F	54	6	1.6	46	84	89	B
10	M	46	15	1.5	23	77	79	B
11	M	47	2	2.0	66	85	89	A
Average.....		*47*	*12*	*1.9*	*38*	*72*	*78*	

tions. E) represented the deaths, as a direct or indirect result of the surgical intervention.

In this group, by definition, there were no E's; moreover, there were no D's and only one C.

RESULTS

Anterior choroidal artery ligation

This group of 7 patients (Table 1) had the longest follow-up period, *viz*, from thirteen to thirty-one months. The average was twenty-one months—certainly long enough to achieve a stable state in Parkinson's disease. The average age was 46. The average subjective score of the patients before operation was 46 (rather a low figure); this had risen to 69 at the time of our examination. Our average objective rating was 75, and the sum of the two was 144.

There were relatively few abnormal neurologic findings aside from the stigmata of Parkinson's disease. In 2 patients there were unilateral extensor plantar reflexes, and in a third patient the condition was bilateral. Three had hyperactive deep tendon reflexes on one side or both. One had mild facial weakness. Sensation was intact as tested by pin-prick, cotton-wool perception, vibration perception, and position sense. There was no definite motor weakness.

In the final evaluation, the degree of surgical relief from tremor and rigidity did sometimes differ widely from that of the symptoms of Parkinson's disease as a whole. In one patient the rating dropped from A to C, and in another from A to B. The former was a patient with quiet limbs who presented a psychoneurotic

state and was not able to be effective, though there was nothing to account for this in the neurologic examination. The other experienced definite relief, but there was progression of the disease process on the opposite side.

Patient #5 was a 41-year-old former Navy Yard mechanic of Italian extraction. Tremor of the right thigh appeared in 1949. There was no history of influenza or encephalitis, and there had been no serious illnesses. In 1951, the tremor involved the right hand and arm, and he stopped work. He was helpless in 1952 and entered a convalescent home. When seen in 1954 before operation, he could not walk, speech was slurred and monotonous, and he could not do anything for himself.

In 1954 a left anterior choroidal artery ligation was performed. The record indicates that he had a stormy time. He was unresponsive for fifteen minutes during operation, and was drowsy and confused for sometime thereafter, leaving the hospital only after weeks had elapsed.

He stated that he was remarkably improved and could dress himself except for tying shoe-laces. He walked, could even run fairly well, and rode a bicycle regularly. However, in the past year he noticed an increase in tremor and rigidity on the left (the side not treated), such that his gait and general ability to get things done had been adversely affected. At no time had he felt well enough to work, and remained a semi-invalid at home. Motion pictures showing his activities before and after operation supported his statements.

Neurologic examination revealed a thick-set, slightly obese man, mentally alert and seemingly clear, but with marked diminution in the volume and clarity of his voice, and an increase in the rate of speech. He was understood only with difficulty. He followed the thought of the interviewers easily and implemented the story with details his wife omitted. There was no euphoria or depression. There was considerable loss of expression and blinking was almost absent. He walked with a curious lumbering gait, dragging the left foot and showing associated movement of only the right arm. "Freezing" on attempted turning was marked. In spite of the slowed gait, he could assume a slow loping canter with a tendency towards forward propulsion without falling.

Tremor was absent on the right, slight in the left forearm, but considerable at the left wrist. There was no tremor in the legs. Rigidity was definite but slight at the right elbow and wrist, more distinct at the corresponding left joints, and marked at the left knee and ankle. Right-handed handwriting was irregular and small but clear. Left-handed circle tracing was impossible, but that of the right hand was good and quickly done. Tendon reflexes were symmetrically slightly increased, with bilateral extensor plantar reflexes.

The objective and subjective findings at the time of examination are shown in Figures 1 and 2.

This man, previously a total invalid in a convalescent home, was a semi-invalid at home, but able to care for himself to a great extent. There was further development of tremor and rigidity on the untreated side, but there was no increase on the treated side. The indubitable neurologic signs were present, but played no practical role in his ability to use the extremities. Surgically and over-all, we rated his condition as B—markedly improved.

Anterior choroidal artery ligation, followed by contralateral alcohol chemopallidectomy

In this category were 4 patients in the fourth decade of life (Table 1). The disease was of both short and long duration. The length of postoperative observation after the second procedure was up to twelve months. The subjective score changed from 38 to 72 after both operations, and the postoperative score aver-

aged 78, confirming the subjective figure. In Patient #8 a good result on both sides was contrasted with abundant signs of general motor inactivity; he sat quietly without spontaneous movement, expressionless and drooling. It appears that this group of rather seriously afflicted patients did so well following arterial ligation that they themselves urged a contralateral procedure. The following case illustrates a good outcome:

Patient #11 was a 49-year-old ship's cook, who in 1953 noted onset of a right-sided tremor, principally in arm. This was rapidly progressive and within a few months he gave up work and sought help. Preoperatively he had advanced tremor of the right side, mostly of the right arm and hand, and a barely perceptible tremor of the left hand. There was a history of psychosexual difficulties and possibly one psychotic episode. He denied influenza or encephalitis. In June 1953 the left anterior choroidal artery was occluded. He then had a two-week psychotic period with hallucinations. Tremor had entirely disappeared. Within a few weeks the after-effects on the psyche had cleared and he returned to sea duty.

In late 1954 there was an increase in left-sided tremor. By late 1955 he again quit work and returned to Dr. Cooper. At this time we first examined him. There was considerable tremor of the left forearm and hand, without rigidity, and associated movement of only the right arm when walking. Knee and ankle jerks were somewhat hyperactive, and plantar reflexes were flexor. His gait was normal aside from the loss of left associated movement. Posture and facial expression were normal. Mentally he was pleasant, but reserved and distant.

In May 1956, a contralateral right alcohol chemopallidectomy was performed. A short period of confusion with motor aphasia followed and one month later there was some trace of hesitancy in word choice in conversation. He was alert and oriented but perhaps slightly duller and less interested than before—at best a minor change. Left sided tremor had disappeared. The gait was slightly slow, and the facial expression perhaps slightly diminished. Tendon reflexes were still somewhat hyperactive, and plantar reflexes were still flexor.

This man exhibited the rather rare occurrence of *almost pure tremor*, involving the right and later the left side, *perfectly relieved by the operations*. There remained only a suggestive mental change towards apathy, which might not be permanent. He was restored to wage-earning capacity.

Patient #10. A 48-year-old former coal miner dated his illness from 1933 or earlier, beginning with tremor of the right foot. The right arm was involved by 1936, the left leg by 1938, and by 1947 he was completely bedridden with tremor and rigidity of the extremities. There was no history of influenza or encephalitis.

In 1954 a right anterior choroidal arterial ligation was performed and considerable functional improvement ensued, with marked diminution of left-sided tremor and rigidity. He could dress himself and get about his room to some degree. Alcohol chemopallidectomy was then performed on the left side in January 1955. Air study disclosed moderate ventricular enlargement. We saw this patient one year after the second operation. He had improved in mobility, and he had been working for a while as a supermarket stock clerk.

Examination showed an alert and interested man with obvious signs of Parkinson's disease. He had considerable loss of expression in the face and a mild, constant drool. There was a tendency to veer to the right when walking. The left arm was held flexed and adducted close to chest. He was able to walk fairly well, go up and down stairs, and get in and out of chairs. Associated arm movement on walking was present on the right only. Tremor and rigidity of the extremities was practically absent. Tendon reflexes were normal. A left extensor plantar response was present. There was a curious apathy about his slightly bent posture, but he would spring to life and perform requested acts such as walking.

This man had a good result from the arterial ligation, which may have caused the left-sided extensor plantar response. The chemopallidectomy seemed to have been effective, producing by our rating a good surgical and over-all result. Yet, the patient still has Parkinson's disease. The lack of desire to make motions of which he is perfectly capable, is interesting. This seems to be due to his disease. However, the effect of the pallidal lesions on both sides must not be overlooked. Dr. Cooper has commented upon such apathy appearing after the second of bilateral operations.

Unilateral alcohol chemopallidectomy

This procedure is favored particularly because of minimal mortality. In this group were 14 patients, with an average age of 49 years (Table 2). The average duration of the Parkinson's disease was ten years. The average preoperative subjective rating was 47, indicating a considerable handicap. The increase following operation was about 30 per cent, a figure checked by the postoperative objective evaluation. Good results were observed among the patients with unilateral involvement of the limbs. Among those with more extensive involvement in many spheres, the results, on the whole, were less good. The following patient illustrates the latter type of result:

Patient #17. A 49-year-old housewife noted tremor and rigidity of the right arm in 1949. Shortly there was extension of the tremor to the left arm. Drug therapy was effective at

TABLE 2

Surgical Treatment of Parkinson's Disease

Patients 12 through 25 underwent unilateral chemical pallidectomy. Patient 26 underwent bilateral chemical pallidectomy.

Patient No.	Sex	Age at Op.	Duration of Disease (Yrs.)		Score (Subjective)		Score (Objective)	Final Evaluation
			Preop.	Postop.	Preop.	Postop.	Postop.	
12	M	67	2	1.0	58	83	88	B
13	M	57	2	0.5	62	93	97	A
14	M	33	22	0.3	16	73	74	B
15	F	46	10	0.4	19	56	77	B
16	M	47	20	0.3	51	90	75	B
17	F	48	6	0.4	38	66	58	C
18	F	51	8	0.6	59	77	83	B
19	M	49	15	1.5	52	73	76	C
20	F	52	7	0.3	36	64	82	B
21	F	51	14	0.5	29	44	66	B
22	F	63	3	0.7	96	100	87	B
23	M	48	13	0.8	34	64	67	B
24	M	39	17	1.0	54	94	98	A
25	M	37	6	0.3	62	84	89	A
26	F	52	5	0.9	59	89	84	B
Average.....		*49*	*10*	*0.6*	*47*	*76*	*87*	

first, but later lost its usefulness. In 1954 the condition in the left arm suddenly became worse. Examination prior to operation disclosed bilateral Parkinson's disease with symptoms more marked on the left.

Right-sided alcohol chemopallidectomy was performed in October 1955. The patient reported 50 per cent improvement. She was able to increase social activity, and tremor and rigidity were improved on both sides. Her right-handed handwriting was better, in her opinion.

Five months after operation we found her with typical stooped posture, expressionless face, a hyperactive blink reflex and frequent blepharospasm. There was slight left facial weakness. The neck muscles were tight posteriorly on both sides. Tremor was absent in the left arm, but slight in both legs. Gait was slow-stepped and festinating. The voice was very monotonous and faint. Left tendon reflexes were hyperactive, and plantar reflexes were flexor. It was difficult to conceive of her having a 50 per cent improvement.

This fortunate woman obtained relief of tremor and rigidity of the left extremities. Although it is granted that her operation was a success, B, we feel that the general result and lack of social rehabilitation merited only a C rating. There was insufficient justification for a contralateral operation. She remained a seriously involved patient seeking relief by means of drugs. In contrast to this discouraging case is the following one, in which the outcome must be considered brilliant.

Patient #24 was a 40-year-old former mine-hoist operator. Eighteen years before, a tremor of the right thumb had developed, which gradually involved more of the arm and led to violent tremor of the extremity. The right leg was also implicated to some extent. The left side remained free of symptoms. Handwriting was impossible. There was some stiffness on the right side of the face, and a curious burning sensation in the right neck and apex of the shoulder. There was no history of influenza or encephalitis. Examination prior to operation revealed a severe right-sided tremor, no associated movement of the right arm in walking, and dragging of the right foot. Motion pictures illustrated this condition well. The patient had been in a chronic hospital for five years before operation. Left chemopallidectomy was performed in February 1955, and the patient stated that he had complete relief of all symptoms. Four months later he began work in a hospital as a volunteer, and later as a paid orderly. Recently he transferred his occupation to a hospital near his home.

We found him, seven months after operation, appearing as a normal individual, with no evidence of Parkinson's disease. There was no tremor or rigidity. Tendon reflexes were normal, and plantar reflexes were flexor.

Here is an instance of unilateral tremor of severe degree entirely relieved by unilateral chemopallidectomy. This patient was to all intents and purposes, cured. The long period of adjustment required before he began to work is not surprising. He had been a chronic hospital inmate for five years but he had not surmounted the hurdle of passive inactivity. It should be stressed that the diffuse motor patterns of Parkinson's disease were not present in his case.

In the unilateral chemopallidectomy group abnormal reflexes and extensor plantar responses were infrequently observed following operation. Of the 14 patients, 3 had bilateral and 1 had unilateral extensor plantar reflexes, and 3 had moderately increased tendon jerks. There was no difficulty which might be attributed to spastic weakness.

Bilateral alcohol chemopallidectomy

We saw only 1 such case—in a 52-year-old woman (Table 2). She had bilateral disease, with gait, postural and motor disturbances, tremor and rigidity. Like Patient # 10 (*see* case history, and Table 1), she obtained relief of tremor and rigidity following operation. However, moderate stigmata in the motor sphere remained unchanged, though not as widespread as in Patient # 10.

DISCUSSION

No lead can be furnished by the data in this paper about the percentage of success or the percentage of complications, because all the patients in the study had had successful operations. To counterbalance this, some data are presented on the 17 patients of R.S.S. who were referred to Dr. Cooper and underwent a total of 20 operations, all of which were alcohol injections. In 2 of these cases, the procedure was bilateral, with a one-year interval between each operation. Following the 20 chemopallidectomies there were 2 deaths and 2 serious and probably permanent hemiplegias. Thus the total complication rate was 20 per cent, which is about three times that of a much larger series of Dr. Cooper's which is described elsewhere. It should be pointed out that the patients one of us (R.S.S.) referred to Dr. Cooper were much more difficult to manage, because they were medical failures—after intensive efforts to treat them with various kinds of pharmacologic preparations. In this group, there were the following chemopallidectomy ratings: 1 A, 12 B, 3 C, 2 D and 2 E. Results were good in just over 65 per cent; if slight improvement were included, the proportion would be around 80 per cent.

Some authors have stated that operations for Parkinson's disease are successful only in the degree that they cause interference with the motor pathway—the pyramidal tract. In our series, although hyperactive reflexes (no clonus) and extensor plantar reflexes were observed following operation, they proved infrequent, particularly in the alcohol-chemopallidectomy series (5 of 11 in the arterial ligation group; 4 of 15 in the alcohol-chemopallidectomy group). Occasionally Parkinson's disease was seen with pyramidal disturbances per se, but there were no cases of clinical spastic weakness. It appears highly likely that the abnormal pyramidal disturbances were a complication due to the anatomic contiguity of the descending motor pathway and the globus pallidus.

In stating the limitations of anterior choroidal artery ligation and alcohol chemopallidectomy, one must list some fortunate and unusual results. For instance, Patient # 18 after unilateral alcohol injection experienced complete and dramatic relief of painful and frequent bilateral, axial neck muscle spasms. In Patient # 3, following choroidal artery ligation, oculogyric crises ceased. Patient # 8 prior to choroidal artery ligation had marked contracture of the left metacarpo-phalangeal joint which seemed permanent; postoperatively, there was renewed motion of the left hand and, surprisingly, almost complete return of the joints to normalacy. Patient # 14 had a right torsion neck spasm similar to

torticollis, which was entirely relieved. Such fortunate results are important and highly suggestive.

A vague state of apathy, of reluctance to make or initiate action, seems to obtain in greater or lesser degree in patients who have undergone bilateral operations. This has been difficult to define, and has been thought to be related to the "lobotomized" state, or to the central activating mechanism. In these patients at least, it seems to bear some significant relationship to the bilateral nature of the pallidal lesion.

At the present time it is impossible to state definitely the relationship between a lesion in the globus pallidus and Parkinson's disease. It has been demonstrated that in these patients tremor and rigidity of the contralateral arm can be relieved in large measure. With certain exceptions already noted, other aspects of the disease (bilateral or axial) concerned with the mechanisms of gait, posture, facial expression, oculogyric crises and speech are unaffected. If the patient exhibits bradykinesia—inability ordinarily to make or sustain movement which is possible under high motivation—it is a sign that operation will not be of much value. This bradykinesia does not seem to be a psychogenic state. Thus, when the possibility of improvement of contralateral tremor and rigidity is weighed against the improbability of help for the other factors mentioned, a disease equation is obtained which indicates the advisability of pallidectomy for the patient in question.

Before summarizing this material it is essential to answer the criticisms that were listed under "General Considerations" in the first part of this paper and the reader should go back to the detailed order of the criticisms so that they do not have to be repeated here.

1. The degree of improvement in the successful neurosurgical cases (classified as A or B) is indicated by the fact that preoperative scores of 30 to 50 almost doubled in the postoperative evaluation. By way of contrast, in a group of 50 cases treated by medical therapy, physiotherapy and attention to medical needs but without surgery, the average increase in the score (even over short periods of six months to a year) was no more than 12 to 20 per cent—approximately half of that achieved following surgery.

2. In this same group of 50 patients undergoing medical therapy, 10 were carefully treated for months by a psychiatric consultant; all forms of psychotherapy, including suggestion, were used. No more than a 5 or 10 per cent change in their scores could be attributed to suggestion or psychotherapy. Furthermore, any change due to hypnosis or suggestion lasts only a few hours or days.

3. In a previous study on the effects of stress in patients with Parkinson's disease it was found that general surgery, severe trauma, or accident invariably causes an exacerbation of the parkinsonism, and in more than half the cases the condition becomes permanently worse. We have observed repeatedly that patients with Parkinson's disease react unfavorably to the stresses of general surgery. In these patients, therefore, we are against general elective operations such as, for example, a massive dental extraction.

4. Variability in symptoms from day to day and hour to hour does not account for more than a 5 per cent variation in the scores, since the objective signs of rigidity and tremor change but little and we have never seen them vary in a significant manner during a careful and complete examination. They have been thoroughly studied and measured for many years in the out-patient and private series of the authors.

5. Hospital rest, other changes in environment, or removal from stress cause little change in the scores, as shown when the patient comes back for check-ups, and do not significantly affect the scores in this type of examination. We have adequate data on hospital studies of approximately 100 patients in whom no surgery was carried out; there were no beneficial results such as reported in this paper.

In summary, these 5 criticisms that might be made have been refuted as completely as possible. They should also be considered in the light of the fact that pallidectomy relieves unilateral rigidity and tremor, and that unilateral alterations from any of the foregoing five causes would be unphysiologic and have not been observed.

In reply to the next 6 questions that were raised: 1) The answer is yes. 2) The answer is also yes, since we have followed patients for an average of 1.9 years in the arterial ligation group, and 0.6 year in the alcohol-injection group. 3) No seizures or other abnormal symptoms were observed in this group as being permanently residual. 4) In the subjective and objective postoperative scores there was definite evidence of better motor performance, ability to do chores and take care of the problems in life. 5) This question cannot be answered from our survey alone, but on the basis of the smaller statistics (even the pessimistic ones of R.S.S.) the proportion of successes was high enough and the complications few enough so that other patients are being continually referred for the procedure. 6) Cases of Parkinson's disease with severe bilateral manifestations and signs of so-called bulbar involvement or mental deterioration of any type, should not be referred for surgery.

SUMMARY

1. A medical evaluation is presented of 26 selected patients with Parkinson's disease, all subjected to two neurosurgical procedures in the hands of one man. Of these, 7 underwent unilateral anterior choroidal artery ligation; 4, arterial ligation followed later by contralateral alcohol chemopallidectomy; 14, unilateral alcohol chemopallidectomy; and 1, bilateral alcohol chemopallidectomy. Postoperative follow-up periods ranged from four to thirty-six months.

2. A method of subjective and objective evaluation leading to final ratings is outlined.

3. Illustrative clinical abstracts are presented.

4. Emphasis has been placed on the results as related to the manifold treatment of the patient as a whole.

5. In these patients a rather uniform, gratifying improvement in contralateral tremor and rigidity was noted.

6. Unpredictable, sometimes striking amelioration of other symptoms was also observed.

7. These two neurosurgical operations affecting the globus pallidus offer strong probability of relief of contralateral tremor and rigidity in Parkinson's disease. The degree of relief often distinctly exceeds that associated with other forms of treatment. These benefits must be related to the status of the patient as a whole.

PREOPERATIVE STUDIES IN SELECTION OF PARKINSONIAN PATIENTS FOR SURGERY

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The purpose of this paper is to present the studies which the parkinsonian patient undergoes when he enters the hospital as a potential candidate for surgery. The results of these studies, which are performed by the neurologist, psychologist and internist and include electroencephalography and electromyography, are integrated with the results of the neurosurgeon's examination of the patient before the final decision regarding surgery is reached.

NEUROLOGIC EXAMINATION

In addition to the routine neurologic examination, a detailed study is made of all the neurologic symptoms associated with Parkinson's syndrome. The two essential and elementary components in the symptom-complex of this disease, are muscular rigidity and tremor. The dynamic evolution of both symptoms is one of the most important facts to be taken into consideration.

Rigidity

In addition to routine testing for the cogwheel phenomenon, covering the joints of the upper and lower extremities, especial attention is paid to two factors. First, in the earlier stage of the disease, the rigidity may be palpable and its effects visible in the proximal muscles of both upper and lower extremities. For instance, in testing the cogwheel quality of the patient's shoulder, some degree of rigidity may be felt at a time when comparable rotation of the wrist reveals no rigidity and the hand still performs its function within the normal range of speed of movement. This explains early loss of the natural swinging of the arm while walking, which may be one of the most incipient symptoms.

The second factor is the differential diagnosis between the spasticity due to pyramidal-tract lesions and rigidity. Rigidity usually affects to an equal degree the agonist and antagonist muscles of any extremity, whereas hypertonicity due to pyramidal lesions is generally more marked in the flexors of the arm and the extensors of the leg. Clonus and the Babinski sign are the landmarks of a pyramidal-tract lesion. Rigidity persists during the entire range of movements tested in any joint. Spasticity may be complicated by contractures and deformities, whereas rigidity is complicated by fixed dystonic postures.

Tremor

Tests are made for hyperkinetic symptoms and the results are carefully recorded, taking into consideration rhythm and amplitude. The tremor is usually present at rest, consists of alternating contractions of antagonistic muscle groups, and usually is more marked in the distal parts of the extremities. Al-

though commonly referred to as tremor at rest, it often appears during motion, and may eventually spread to the proximal parts of the extremities as well as to truncal and nuchal musculature. Intensified by emotional stress, it almost disappears during sleep. Usually the tremor increases in violence as the disease progresses. However, in some instances, as rigidity increases and the patient becomes relatively immobile, the tremor may become less noticeable.

Voluntary movements

Dysbasia (abnormal gait) usually appears early in the course of the disease and in most instances the abnormality of gait progresses to such a degree that the patient can no longer walk unaided. Detailed records are made of such manifestations, as the dragging of one leg, marche à petits pas, or actual festination. Extreme slowness of voluntary movement, so-called bradykinesia, usually reflects the degree of rigidity. However, the relationship between the akinetic symptoms and the hypertonicity is carefully explored, because when the akinesia is very pronounced and not related to the rigidity, we suspect some other lesion such as cortical deterioration; and this should be taken into consideration before deciding on the surgical procedure.

Akathisia

The patient restlessly turns in his chair, changes position or rises, only to resume his seat; inaction seems to be unbearable. This akathisia should be taken into consideration when the psychologic studies are performed.

Impairment of speech

Impairment of speech may reflect weakness and stiffness of the muscles of phonation and articulation, and sometimes includes akinetic mutism. However, the speech disorder may actually be a degenerative lesion, such as pseudobulbar palsy. A careful study of the speech disturbance should be made, in order to rule out the possible co-existence of pseudobulbar palsy or mental deterioration.

Autonomic symptoms

One of the most common symptoms is sialorrhea, which is explained by some as a weakness of the oropharyngeal muscles, and by others as hypersecretion of the salivary glands.

Hyperhydrosis is sometimes diffuse, involving the entire body. It may be accompanied by a greasy sebaceous secretion covering the skin.

Vasomotor symptoms include hypothermia of the extremities, changes in color of the skin, and local edema. Spontaneous hyperthermia is a vegetative phenomenon which should be carefully investigated before the surgical procedure is recommended.

PSYCHOLOGIC EVALUATION

In the preoperative studies, psychologic factors involved in selection of parkinsonian patients for surgery should be appraised from the broadest stand-

point. All sources of data should be utilized. Detailed histories are taken and a series of psychologic tests administered. In addition, the patient's current situation is reviewed in detail, including his activities, attitudes and goals. The purpose of the psychologic evaluation is to provide the neurosurgeon with sufficient information to enable him to eliminate as surgical candidates those patients who may present psychologic or intellectual postoperative difficulties which would mitigate the beneficial results of surgery.

Because this work-up concerns the patient's total situation, it is frequently necessary for the psychologist to go beyond the narrow aspects of personality and intellectual functioning, and deal with total behavior and the current situation of the patient. In general, a candidate may be considered a poor risk for surgery on psychologic grounds, if: 1) he is not able to tolerate the stress of the surgical procedure itself; 2) predicted postoperative behavior may mitigate the relief afforded by surgery, in that complications in the form of cognitive, affective and conative disturbances may cloud an otherwise successful result; and 3) psychologic factors may interfere with the patient's ability to adjust adequately to his new postoperative situation, regardless of whether the surgery is successful or not.

The work-up should be as complete as possible, including life history, clinical interviews and psychometric studies. Even with this information, the examiner must take into account the psychologic stress consequent to the social, vocational and physical changes which are associated with the illness itself.

Since it is so essential to weigh benefits against risks on an individual basis, no rule of thumb is available, and psychologic evaluation is in this sense unique for each patient.

In order to provide the neurosurgeon with his final evaluation of a candidate, the psychologist utilizes information from all possible sources. Although to date no generalizations can be made concerning definitive negative findings, there are some principles which have been found helpful in forecasting postoperative results. For purposes of discussion, the general problems with which the psychologist deals can be divided into three basic categories. This discussion is based primarily on clinical rather than statistical data, since the tremendous variety of factors to be considered in each case makes statistical generalizations impossible.

A. *Historical factors*

In the detailed life history of each patient, special emphasis is put on areas dealing with patient's earlier life adjustments and previous reactions to stress situations, inasmuch as ability to deal with stress has been found a reliable prognostic index.

Specific areas dealt with in this regard consist of:

1. *Past reactions to stress.* Reactions in the past to illness in family, financial setbacks, or other anxiety-provoking situations may provide us with data as to future behavior under stress.

2. *Perceived cause of illness.* This concerns the patient's own feelings in regard

to the cause of his illness. When he offers personal causes such as overwork, aggravation and tension, rather than physical causes such as flu or some other disorder, this may point to the patient's attitude in regard to his ability to withstand stress.

3. *Adjustment to current illness.* An attempt is made to evaluate the patient's current level of emotional adjustment to his illness. Marked depression, resignation, and loss of initiative are considered as signs of inadequate adjustment, and thus contraindicative to success in postoperative recovery and rehabilitation.

4. *Level of recent activities.* Along with consideration of the severity of the patient's physical symptoms, an evaluation is made of his current level of activities. When an evident disparity exists between the severity of symptoms and the level of the patient's current activities (*e.g.*, a patient with mild symptoms who is unable to feed or dress himself), this is regarded as a negative sign. In such a case, it would appear that factors other than the parkinsonism are at work.

Although the foregoing aspects of the patient's history are of clinical importance for the individual case, no general rules have been established, and no single factor furnishes conclusive evidence. Data regarding numerous other personal areas have been found to be of no prognostic significance so far as selection of candidates is concerned. These include age (within limits), sex, education, vocational background, marital status, and length of illness.

B. *Current situation*

Broadly speaking, the pertinent factors in the candidate's current status are certain aspects of his disability, social and vocational situation, and his goals and attitudes with regard to the surgery.

1. *Disability.* Since we are basically concerned with possible benefits as weighed against risk, the degree of present disability is important. The risk remains more or less constant at a given time. A greater disability may warrant more risk than a lesser one. We are interested in whether the patient is employed or has any dependents, and in his future personal plans. No definitive statement can be made in regard to contraindications to operation, since they must be regarded in the light of the total situation and decided on an individual basis.

2. *Goals and aspirations.* It is important to understand what the patient himself expects from surgery. When his goals are unrealistic, *e.g.*, if he expects personal problems to be solved by the surgery, this may be a contraindication. Here again the specific factor must be appraised in relation to the total situation.

C. *Intellectual and personality factors*

A broad series of personality, intelligence and perception tests are administered to each patient in order to secure an intensive evaluation in this regard. The primary concern is to appraise the patient's current level of adjustment in these categories and to detect factors which in our experience are contraindica-

tions to surgery. In general, the greater the pathologic manifestations, the greater the possibility of contraindication. However, there are specific areas in which pathologic signs present the greatest concern.

1. *The organic mental syndrome.* This may be due to the organic effects of parkinsonism itself, or due to effects of various anti-parkinsonian drugs. Whatever the cause, it usually manifests itself in memory impairment, and difficulty in attention, concentration, and problems requiring organization and integration of the thinking processes. In the typical situation, there is deterioration in several areas of intellectual functioning. Such a candidate can be expected to have an extremely slow postoperative recovery. The ultimate pathologic condition in this direction is the organic psychosis, which is marked by severe disorganization in all thought processes.

2. *Schizophrenia.* Although it has not been established on a group level, schizophrenia, especially of the paranoid type, is a contraindication to surgery. It is felt that the stress of the surgery may serve to intensify pathologic behavior of that nature. In cases in which the schizophrenia is not overt, signs of marked suspiciousness, reality distortion, or personality regression are clinically considered to be poor prognostic signs. A past history of mental illness, although not necessarily a deciding factor, should be taken into consideration. The nature of these conditions is such that the process of postoperative recovery and readjustment is slow and frequently incomplete.

3. *Anxiety and panic states.* The presence of marked anxiety or panic, especially when its object is not the forthcoming operation, but a personal problem (*e.g.*, the death of a loved one), indicates difficulty in dealing adequately with stress and anxiety, and is considered a poor prognostic sign.

4. *Passivity and dependency.* This is considered a contraindication to surgery when it is so marked that it interferes with the motivation and drive necessary for postoperative recovery and rehabilitation. In such a case, the personality factors may work against rehabilitation to independent living.

5. *Personality.* Whether the rigidity and constriction constitute a reaction to the illness or a basic personality characteristic, the condition may tend to create problems in adjusting to the postoperative situation. New adaptations may come with difficulty. Here again, the personality pattern may mitigate successful surgical results.

6. *Depression.* A reactive depression is not an uncommon finding among parkinsonian patients and is generally not considered to be a contraindication to surgery. When the depression appears to be pervasive and basic to the personality structure, however, the patient is usually a poor risk. In such a situation, the depression can be expected to interfere with postoperative recovery and further rehabilitation.

PHYSICAL EXAMINATION

A complete physical examination is made by the internist. The following are the most important facts that should be taken into consideration, especially from the geriatric standpoint:

Respiratory system

Routine chest films are studied. A potential problem arises in relation to pulmonary difficulties secondary to severe kyphosis and poor respiratory excursion. Although the resulting postural emphysema usually does not markedly decrease pulmonary function, the ability to recover from postoperative respiratory infections would likely be impaired. Thus, it is essential to determine the preoperative vital capacity, degree of exercise limitation, and the history as it relates to chronic bronchitis and frequency of pneumonia. These factors serve to indicate the cases in which postoperative pulmonary failure may develop. Decreased pulmonary reserve is considered a relative contraindication and should be regarded in the light of what the patient can expect from relief of his primary disease. Although it is reasonable to assume that unilateral loss of rigidity would not markedly improve pulmonary function, a postoperative increase in vital capacity has been observed in some cases.

Cardiovascular system

Since chest pain may originate from rigidity of the trunk muscles, and peripheral edema may be secondary to Parkinson's disease, a patient who gives a first impression of arteriosclerotic heart disease may prove to have only minimal or no changes due to cardiovascular involvement. No patient with moderate or severe congestive heart failure, uncontrolled arrhythmia, severe hypertension, or recent myocardial infarction should undergo operation. If such patients present themselves and are otherwise suitable candidates, there would be no contraindication to chemopallidectomy after digitalization and maximum correction of heart failure. Hypertension has been rare in our parkinsonian cases in spite of the age group; in fact, a more likely finding is hypotension. The frequency of hypotension in parkinsonism remains unexplained, but it appears to carry no added risk in chemopallidectomy. Hypertension is considered a definite added risk, and efforts should be made preoperatively to lower the blood pressure. Moderate to severe hypertension is considered a relative contraindication.

Gastro-intestinal system

Patients with a history of peptic ulcer or evidence of recent gastro-intestinal bleeding are studied further, as these factors carry an increased risk. Operation should be postponed until further investigation is accomplished. The known incidence of ulceration and malacia of the upper gastro-intestinal tract following neurosurgical procedures would preclude an elective neurosurgical operation in an active case of ulcer. A history of peptic ulcer, but no recent bleeding or signs of activity, may be considered a relative contraindication. In these cases, the decision to recommend operation is made after carefully weighing the degree of parkinsonian incapacitation against the risk and the ultimate results.

Hematologic studies

Preoperative hematologic studies include a base-line hemogram, bleeding time, clotting time, and prothrombin time. A prothrombin consumption test

and platelet count are performed in selected cases. Preoperative studies during the past year have revealed no hematologic changes of significance, except severe secondary anemia. Investigation of these cases of anemia usually revealed chronic gastro-intestinal bleeding, and therefore operation could not be performed.

Renal studies

Blood creatine determinations and urinalyses are carried out routinely. If indicated, base-line electrolyte studies are made. Patients with chronic renal disease are considered poor candidates because of the added risk of postoperative renal infection and electrolyte imbalance. Postoperative renal infection is most likely to occur in patients who require bladder catheterization after surgery. For this reason, it is important to determine the degree of prostatic enlargement. If infection is present, bacteriologic and sensitivity studies should be made.

SUMMARY AND CONCLUSIONS

An outline has been presented of the studies which any parkinsonian patient should undergo upon entering the hospital as a potential candidate for surgery. The dynamic evaluation of the two essential and elementary components in the parkinsonian syndrome—rigidity and tremor—is one of the most important criteria. However, great care must be exercised to appraise all of the symptoms.

A complete psychologic evaluation is made, in order to provide the neurosurgeon with all possible information about surgical candidates who may present postoperative difficulties on a psychologic or intellectual basis, thus mitigating the beneficial results of surgery.

Specific areas are carefully studied—namely, past reaction to stress, perceived course of illness, adjustment to current illness, level of recent activities and the current situation. A broad series of personality, intelligence and perception tests is administered. Certain contraindications to operation, including the organic mental syndrome, schizophrenia, and anxiety and personality disturbances, are discussed.

A complete physical examination is made by the internist. Respiratory, cardiovascular, gastro-intestinal, hematologic and renal studies are performed. The most important physical contraindications to operation, especially from the geriatric standpoint, are outlined.

On the basis of this preoperative over-all appraisal, the neurosurgeon can reach an informed opinion as to whether or not a particular parkinsonian patient should be considered as a candidate for chemopallidectomy.

A GRAPHIC METHOD FOR EVALUATION OF PARKINSONIAN PATIENTS UNDER TREATMENT

DAVID FAIRMAN, M.D. AND ROBERT S. SCHWAB, M.D.

In the last two years we have used several charts and questionnaires to help in the evaluation of parkinsonian patients and for follow-up studies of the treatment program. Since different investigators frequently use different charts and questionnaires, we find ourselves sometimes speaking a different language because the advantages or disadvantages of the treatment are determined from different points of reference. For this reason we considered a standard simple graphic chart in which the data could be recorded and appraised in both a visual and arithmetical manner, by a graph and by a point score. Although Parkinson's disease presents multiple features, we charted only some of the essential ones in the graph. The purpose of this paper is to report this newly developed graphic method for evaluation of some of the objective and subjective symptoms of Parkinson's disease.

PROCEDURE

It was decided to use 5 subjective and 5 objective symptoms. For the objective symptoms we chose the 2 dominant manifestations in the parkinsonian patient—rigidity and temor—because these specific symptoms are the ones which are benefited, either medically or surgically. In determination of the over-all motor involvement we included the degree of akinesia and motor impairment.

For the subjective appraisal we charted the activities of daily life such as *dressing*, toilet activities (*e.g.*, washing and shaving), eating and walking, and morale and mental outlook. This information was recorded after discussion with the patient and relatives.

As indicated in Figure 1, the first column refers to the rigidity of the patient's right side, scored from 0 to 10. A score of 10 indicates normal tonicity, and 0 the most severe degree of rigidity. We test for the cogwheel phenomenon in the proximal and distal joints of both the upper and lower extremities. The rating itself represents the average rigidity for that side. A similar examination is made on the left side.

Intensity of tremor is scored on a scale in which 0 represents the most severe shaking, and 10 indicates no tremor.

For facilitating visual inspection of the chart (Figure 1), right-sided rigidity and right-sided tremor are adjacent, as are left-sided rigidity and left-sided tremor. The rating is based upon the degree of impairment in the particular area. The scale ranges from 10 (no impairment) to 0 (complete inability to perform the activity). For both the objective and subjective scales the maximum score is 50, which represents normality. The degree of impairment is a function of the number of points below the maximum score. For example, a score of 30 points subjective and 20 points objective yields a total score of 50 out of a pos-

H-40

Rfd. by:

CLINICAL RATING SHEET

Name _____ Date of Rating (Pre) _____

Address _____ Date of Rating (Post) _____

_____ Date of Operation _____

Side of Oper. _____ Age ___ Born _____ Examiner _____

Preferred Hand _____

	Objective						Subjective					
	RR	RT	LR	LT	MO	Base Line	D	T	E	W	A	
0												0
++++ 1						Pre						1 ++++
2												2
						Obj.=						
+++ 3												3 +++
4						Subj.=						4
++ 5						Post						5 ++
6												6
						Obj.=						
+ 7												7 +
8						Subj.=						8
o 9						Total=						9
10												10 o

Symbols

RR - Right Side Rigidity
RT - Right Side Tremor
LR - Left Side Rigidity
LT - Left Side Tremor
MO - Overall Motor Involvement

D - Dressing Activities
T - Toilet Activities
E - Eating Activities
W - Walking and Indoor Activities
A - Attitude and Mental Outlook

Comments:

FIGURE 1

sible 100, which means that the patient has lost 50 per cent of his normal capacity from both the objective and subjective standpoints.

CASE PRESENTATIONS

Figure 2 represents the findings in a patient with marked rigidity and tremor on the left side but minimal involvement on the right side. The chart indicates that rigidity is slightly more pronounced than tremor. The over-all motor involvement score is 6, which indicates that the patient has lost 40 per cent of his capacity in this area. The subjective scale indicates some impairment in all activities, ranging from 40 per cent impairment in attitude and mental outlook to 70 per cent impairment in eating activities.

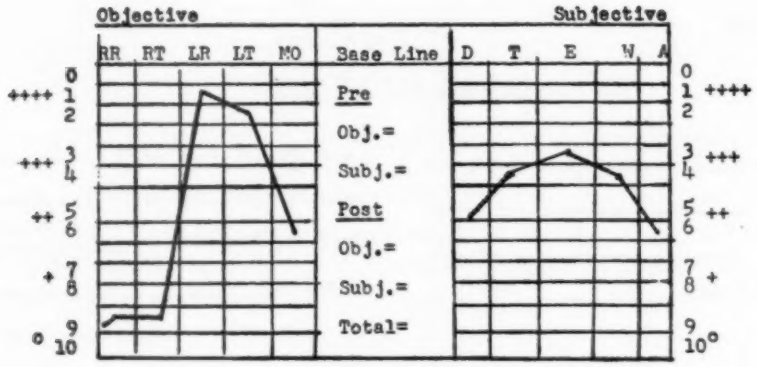

FIGURE 2

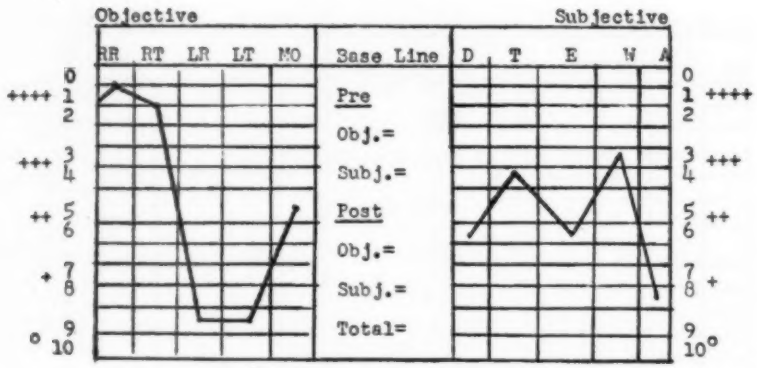

FIGURE 3

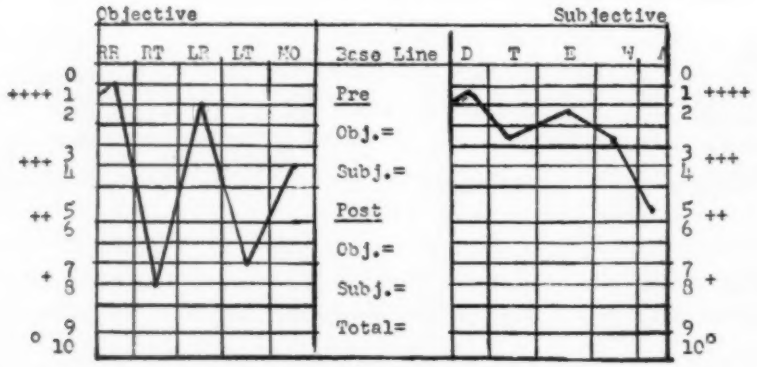

FIGURE 4

Figure 3 shows the data in a case of Parkinson's disease with minimal rigidity and tremor on the left side and marked involvement on the right side, tremor being slightly more pronounced than rigidity. As far as the over-all motor activities are concerned, a rating of 5 indicates that the patient has lost 50 per cent of his motor capacity. The subjective evaluation shows that some degree of impairment exists in all activities, ranging from 20 per cent in the category of attitude and mental outlook to 40 per cent in the category of toilet activity.

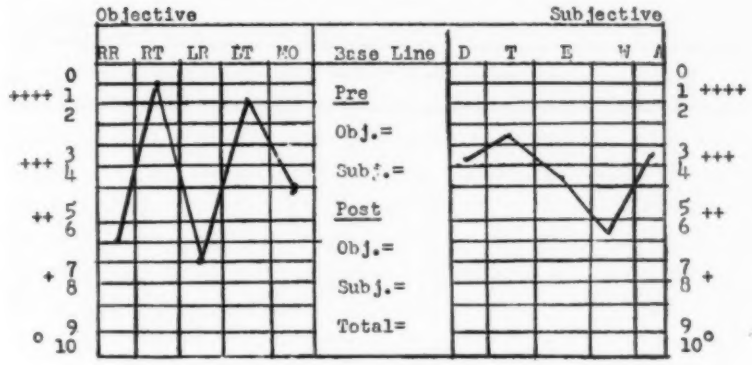

FIGURE 5

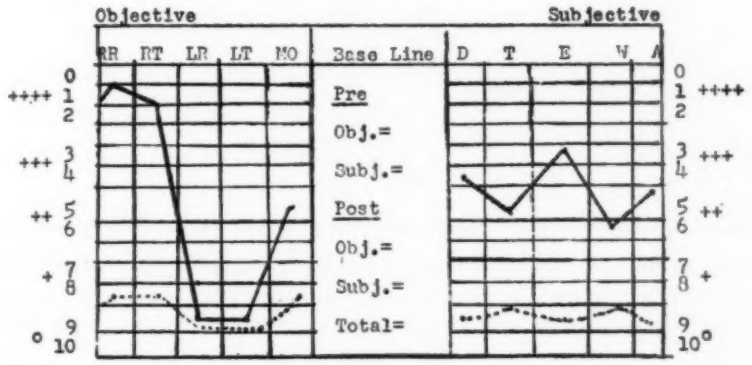

FIGURE 6

Figure 4 represents the findings in a patient with bilateral increased hypertonicity, more pronounced on the right than on the left. Hyperkinetic symptoms are of minimal degree on both sides, slightly more pronounced on the left. The over-all motor involvement rating shows that the patient has lost 70 per cent of his capacity. From the subjective standpoint, there is a variation in the degree of impairment, ranging from as much as 80 per cent in dressing activities to 50 per cent as far as mental attitude is concerned.

Figure 5 is the chart of a patient with marked tremor of the extremities of both sides, rigidity being present in a very slight degree. In regard to the over-all motor involvement, this patient has lost 60 per cent of his capacity In the subjective evaluation, toilet activities are most impaired, but the patient retains 60 per cent of his capacity to walk.

In Figure 6 the solid lines represent the preoperative status of a patient with parkinsonism, showing that rigidity and tremor were severe on the right side. The over-all motor involvement is scored as 5. The subjective data show that the patient was impaired to about 50 per cent of his capacity. The dotted lines in the chart show the degree of diminution in the symptoms of hyperkinesia and hypertonicity and the recovery in the functional capacity from the subjective standpoint four weeks postoperatively. In summary, this patient had a preoperative

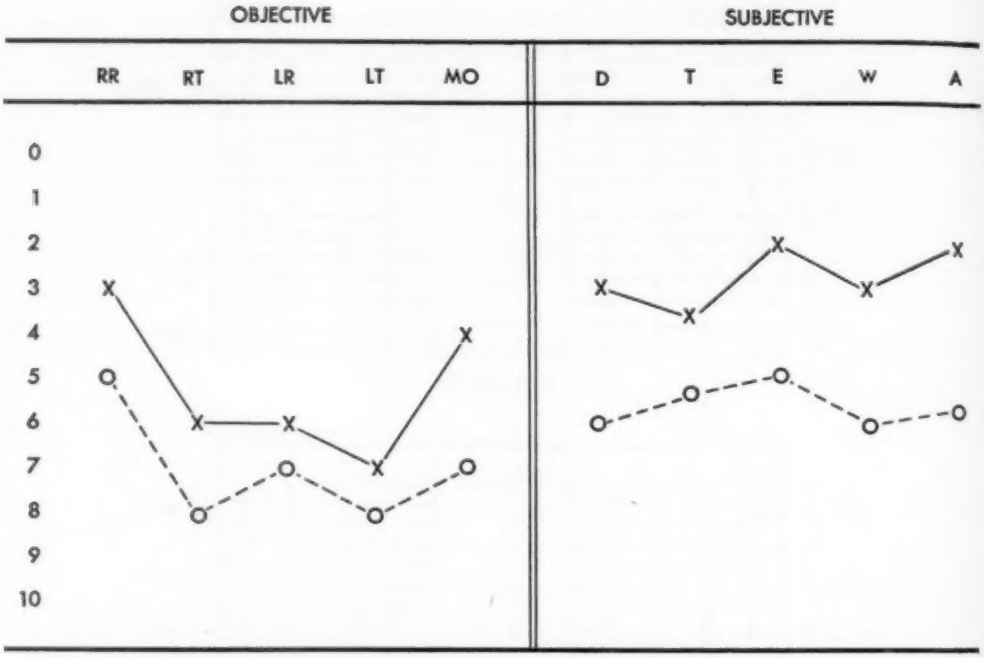

FIG. 7. Showing the typical improvement that can be achieved by the use of drugs in a patient with bilateral parkinsonism symptoms. The solid lines represent the scores when the patient was first seen by one of us in January 1955. The dotted lines represent the maintained improvement over a 14-month period ending when the patient was examined in April 1956. The explanation of the symbols is in Figure 1.

Note that there is more rigidity on the right side than on the left. The tremor is also slightly worse on the right. Motor activities such as shaving or tying shoe-laces, were rated as 40 per cent of normal objectively when the patient was first seen but the patient's subjective report made the rating about 5 per cent below this score.

After the patient had been adequately regulated on a mixture of Kemadrin-Thephorin and Parsidol his rating reached an average objective level of 70 per cent of normal, which was approximately 5 per cent above the subjective estimation (65 per cent). This represents a rather typical case of the good results obtainable with medical therapy of Parkinson's disease.

total score of 47 points; postoperatively impairment was such that he now functions at 87 per cent of normal.

Figure 7 illustrates a good result following medical therapy in a case of Parkinson's disease.

SUMMARY

A new graphic chart for evaluation of parkinsonian patients has been presented. Five objective and 5 subjective symptoms have been selected and recorded graphically and arithmetically. Rigidity and tremor were chosen as manifestations within the objective area because they represent the specific symptoms which can be benefited medically or surgically. The subjective ap-

praisal is made after discussion with the patient and his family concerning his functioning in the various activities of daily living.

This graphic method, because of its simplicity, permits upon cursory observation an estimation of the presence and intensity of the most important symptoms. The total score of the ratings yields a numerical value for use in determining the status of the patient. By recording in the same chart or in successive charts the graphic curve and the score of points, it is possible to determine in a dynamic way the evolution of symptoms before and after surgical or medical treatment of Parkinson's disease.

EFFECTS OF ANTERIOR CHOROIDAL ARTERY OCCLUSION AND OF CHEMOPALLIDECTOMY ON THE TREMOR AND RIGIDITY OF PARKINSON'S DISEASE: AN INDEPENDENT APPRAISAL

LEONARD DILLER, PH.D., MANUEL RIKLAN, PH.D. AND ZOFIA LASZEWSKI, M.D.

After it became clear that anterior choroidal artery occlusion showed promise as a therapeutic technique capable of relieving the distress of Parkinson's disease, it was decided to utilize an independent team to evaluate the results of this operation, as well as further neurosurgical procedures such as the chemopallidectomy. The general proposition that tremor and rigidity could be relieved without sacrifice in motor power deserved as complete and careful documentation as possible. It was, therefore, decided to use observations of these motor disturbances as the focal point for an independent survey of a large number of cases.

While new instruments which would measure dimensions of behavior pertinent to this question were being explored (1), clinical ratings served as useful primary data. Such ratings have the advantage of permitting a global assessment of the area under consideration, *i.e.*, they permit a clinical evaluation of the various factors which may influence and perhaps distort a single measure. In addition, they are easy to obtain. The chief disadvantage of clinical ratings lies in the fact that the human observer is subject to error and prejudice. A mechanical device, on the other hand, may be applied by different examiners in different settings. However, in spite of the patent objections, we reasoned that the objectivity of the clinical findings could be postulated to the extent that inter-observer agreement was established. If a sufficiently high degree of agreement were obtained, the clinical findings could be accepted with some degree of confidence.

PROCEDURE

Two series of consecutive parkinsonian patients who had been treated by neurosurgical procedures were examined approximately three to six weeks after operation, at the time of discharge from the hospital. The first group consisted of the last 16 patients who had undergone occlusion of the anterior choroidal artery and the first 44 who had undergone subtemporal chemopallidectomy. The second group consisted of the last 15 patients who had been treated by subtemporal chemopallidectomy, and the first 37 who had been treated by transfrontal chemopallidectomy. Each patient was generally rated by a minimum of three staff members—2 neurosurgical residents, 2 psychologists, a physiatrist, a speech therapist, an internist, a nurse, and 2 physical therapists (2, 3, 4). In line with our purpose, the patients were rated for preoperative impairment on the basis of a three-point scale—mild, moderate and severe in regard to tremor and rigidity. Postoperatively, each patient was rated as +1 (better), 0 (same), or −1 (worse).

The average inter-observer agreement for the first series of patients was 85

TABLE 1

Effects of Anterior Choroidal Artery Occlusion, and Subtemporal and Transfrontal Chemopallidectomy on Tremor and Rigidity

Neurosurgical Procedure	Improved	Not Improved	No. of Cases
Anterior Choroidal Artery Occlusion	10 (63%)	6 (37%)	16
Subtemporal Chemopallidectomy	42 (71%)	17 (29%)	59
Transfrontal Chemopallidectomy	34 (91%)	3 (9%)	37
Total	*86 (77%)*	*26 (23%)*	*112*

per cent (P = .001) and for the second series, 80 per cent (P = .001). When differences occurred, they were discussed among the judges. When some disagreement persisted, a pooled mean score was utilized.

Because of technical and administrative difficulties, it was not possible to obtain thorough examinations of all of the patients undergoing neurosurgery. However, the samples were selected on a consecutive and random basis and were thought to be representative of the group. They constituted, except in a few instances, the entire block of new admissions for surgical treatment of Parkinson's disease between May 1954 and May 1956. Actuarial data on the life characteristics of these patients prior to surgery are presented elsewhere in this series (5).

RESULTS

Anterior choroidal artery occlusion

As shown in Table 1, among 16 patients who underwent occlusion of the anterior choroidal artery, tremor and rigidity improved in 63 per cent; there was no improvement in the other 37 per cent. Among the 6 patients rated as not improved, tremor and rigidity remained essentially the same in 3, and in 3 became worse; of the latter 3 patients, 1 died, 1 became hemiplegic and 1 became hemiparetic.

Subtemporal chemopallidectomy

Of the 59 patients in this group, 71 per cent were rated as improved and 29 per cent as unimproved (Table 1). Among the 17 unimproved patients, 16 per cent were the same, and 13 per cent were worse with respect to tremor and rigidity. In the latter group, 2 deaths were recorded.

Transfrontal chemopallidectomy

In the transfrontal group of 37 patients, 91 per cent were rated as improved and 9 per cent as unimproved. Among the unimproved, 2 cases of hemiparesis developed.

COMMENT

1. Our measures of tremor and rigidity did not distinguish the amount of improvement in individual cases. However, improvements ranging from slight diminution to complete disappearance of these symptoms were encompassed by the ratings.

2. Two other areas of practical importance for parkinsonian patients—ability to perform activities of daily living in an independent fashion and mental status—were also explored via ratings. Generalizations from observations in these areas cannot be considered conclusive, because recuperation from operation may influence a patient's status in this respect during the first weeks following surgery. Variation in response patterns were noted. In approximately 40 per cent of the group there were gains in the ability to perform the activities of daily living (6) and in about 25 per cent there was evidence of improved mental status (attitudes, mood). On the other hand, there were several instances of regression and difficulties in these areas. These occurred in almost a fourth of the patients with respect to the activities of daily living, and in about a third of the patients with respect to mental status.

SUMMARY

In a study of the effect of neurosurgical procedures on the tremor and rigidity of Parkinson's disease, from four to six weeks after operation, a team of independent investigators observed improvement in 63 per cent of 16 cases of anterior choroidal artery occlusion, in 71 per cent of 59 cases of subtemporal chemopallidectomy, and in 91 per cent of 37 cases of transfrontal chemopallidectomy.

REFERENCES

1. Riklan, M., and Diller, L.: Certain psychomotor aspects of subtemporal chemopallidectomy in Parkinson's disease, *J. Am. Geriatrics Soc.* **4:** 1258–1265 (Dec.) 1956.
2. Buck, J. F., and Cooper, I. S.: Speech problems in parkinsonian patients undergoing anterior choroidal artery occlusion or chemopallidectomy, *J. Am. Geriatrics Soc.* **4:** 1285–1290 (Dec.) 1956.
3. Diller, L., and Riklan, M.: Rorschach correlates in Parkinson's disease: motor inhibition, cause of disability and self-revelation, *Psychosom. Med.* (in press).
4. Diller, L.; Riklan, M., and Wood, J.: Follow-up study of the results of anterior choroidal artery occlusion and subtemporal chemopallidectomy in Parkinson's disease: an independent appraisal, *J. Am. Geriatrics Soc.* **4:** 1249–1257 (Dec.) 1956.
5. Diller, L., and Riklan, M.: Psychosocial factors in Parkinson's disease, *J. Am. Geriatrics Soc.* **4:** 1291–1300 (Dec.) 1956.
6. Buchwald, E.; Rusk, H. A.; Deaver, G. G., and Covalt, D. A.: Physical Rehabilitation for Daily Living. New York, McGraw-Hill, 1952, p. 200.

FOLLOW-UP STUDY OF THE RESULTS OF ANTERIOR CHOROIDAL ARTERY OCCLUSION AND SUBTEMPORAL CHEMOPALLIDECTOMY IN PARKINSON'S DISEASE: AN INDEPENDENT APPRAISAL

LEONARD DILLER, PH.D., MANUEL RIKLAN, PH.D. AND JOSEPHINE WOOD

INTRODUCTION

In another paper of this symposium (1), the results of independent examinations of the short-range effects of anterior choroidal occlusion and chemopallidectomy have been reported. These findings confirm some of the impressions reported earlier by Cooper (2, 3) in regard to the efficacy of these procedures in relieving tremor and rigidity in Parkinson's disease. Preliminary follow-up studies by Cooper and his associates (4) have shown that the benefits of surgery have been maintained a year and more. The question of the permanency of the relief of tremor, rigidity and other symptoms is an important one. Therefore, a detailed questionnaire was prepared and sent to several patients who had undergone either anterior choroidal artery occlusion or subtemporal chemopallidectomy. It is the aim of this report to present the evidence gathered from these questionnaires as a contribution to the evaluation of the long-term results of these operations.

PROCEDURE

In order to arrive at a uniform and systematic method of assessing the functioning of the patients at a given time after operation, an extensive questionnaire was constructed. This instrument was used, rather than personal observations or interviews, inasmuch as many of the patients lived in distant places and were therefore not available for personal examination. The various items were selected primarily on the basis of changes observed in the patients during the weeks immediately subsequent to the operation. In addition, subjective statements made by patients postoperatively during clinical examinations were organized and integrated in the questionnaire. Attempts were made to phrase the questions in a simple, unambiguous manner. They were so chosen as to be grossly applicable to the entire group, and readable by both patients and their families. Although it was recognized that many significant physical and psychologic data could not be gathered by such an imprecise instrument, it was felt that this questionnaire could supply information for a gross outline of the observed changes, and also point out areas calling for more intense observations at a later date.

The questionnaire pertained to 3 main areas:

A. Various factors directly related to motor disturbances, including the current status of: 1) tremor, 2) rigidity, 3) the activities of daily living (25 items performed independently), 4) recurrence of motor disturbances, and 5) changes noted during the previous three months.

B. Various factors pertaining essentially to non-motor problems which are common in Parkinson patients, including oiliness of the skin, nervousness, speech

difficulties, depression, loss of memory, and undue fatigue. Information was also sought regarding over-all health, employment status, and degree of contribution to the household.

C. Various factors pertaining to attitudes toward surgery, including original expectations, satisfaction with the results, and willingness to undergo the same procedure under the same circumstances.

Whenever possible, the patient was asked to compare his current status with his preoperative condition.

The questionnaire was so designed as to encourage explanations in addition to objective answers. When a patient could not respond himself, he could consult with members of his family or, if necessary, the family was asked to answer questions through their own observations of the patient's condition.

The follow-up questionnaire was sent to the last 27 patients who had undergone anterior choroidal artery occlusion, and the first 37 who had undergone subtemporal chemopallidectomy. For the choroidal occlusion group, the postoperative follow-up period ranged from eighteen to thirty-six months, and for the chemopallidectomy group, from nine to thirteen months. Answers to the questionnaire were obtained from 85 per cent of the choroidal occlusion group and from 84 per cent of the chemopallidectomy group.

Among the 23 choroidal occlusion patients from whom answers to the questionnaire were received, only 14 had been seen preoperatively for intensive psychologic and medical evaluation.[1] In the chemopallidectomy series 31 answers to the questionnaire were received. All these patients had been intensively evaluated both preoperatively and postoperatively, and a mean of approximately one year had elapsed since operation. Two patients were reported to have died some months after discharge from the hospital. The cause of death was not stated. These patients will not be included in the tabulations which follow.

The over-all 85 per cent response to the questionnaire for both groups suggests that a relatively unbiased sample of postoperative cases was tapped. Yet the problem of the validity of such self-ratings remains a pertinent one. In an attempt to meet this problem, at least in part, a small number of patients who returned to Dr. Cooper for postoperative check-up were personally observed by 2 examiners (L.D. and M.R.) and correlations were made between the ratings filled out on the questionnaire by the examiners and the self-ratings filled out by the patients. Ten patients who were thus observed. There was nearly complete agreement between patient-ratings and examiner-ratings in the major categories. The examiners felt that the self-ratings were relatively candid, partly because the patients were told that the purpose of the research was to help other patients as well as themselves.

[1] Since our own preoperative evaluation was begun some time after the anterior choroidal occlusion series was under way, our findings do not include those in the earlier patients in the series. We have attempted, however, to remove any bias from the sample by 1) including all parkinsonian patients who were seen at the time of admission for surgery, and 2) including those who were seen postoperatively by the full team of rehabilitation specialists.

TABLE 1

Summary of Responses to Follow-up Questionnaire by 52 Parkinsonian Patients who had undergone a Neurosurgical Operation

Sign	Anterior Choroidal Artery Occlusion (23 patients)			Chemopallidectomy (29 patients)		
	Better	Same	Worse	Better	Same	Worse
Tremor	17	4	2	23	2	4
Rigidity	16	2	5	18	6	5
Ability to perform activities of daily living	12	6	5	19	4	6

RESULTS

The results are presented under three main headings: (a) motor factors, (b) non-motor factors, and (c) attitudinal factors.

A. *Motor factors*

Table 1 shows the status of tremor, rigidity and ability to carry out independent activities of daily living, when compared with preoperative status.

1. *Tremor.* Seventy-five per cent of the choroidal occlusion patients and 79 per cent of the chemopallidectomy patients stated that tremor was reduced or absent; *77 per cent of both groups reported improvement in tremor without any motor weakness.* About 11 per cent of both groups reported that they had more tremor than before operation. These patients were largely unimproved at the time of hospital discharge. *It thus appears that reduction in tremor is, for the most part, permanent following both types of surgery.*

2. *Rigidity.* In several patients of each group rigidity was benefited by surgery. There was improvement in 69 per cent of the choroidal occlusion group and in 62 per cent of the chemopallidectomy group. In 22 per cent of the former and in 17 per cent of the latter group, rigidity was reported as "worse."[2]

3. *Activities of daily living.* In 52 per cent of the choroidal occlusion group and 65 per cent of the chemopallidectomy group there was improvement in carrying out the activities of daily living. Twenty-two per cent of the original choroidal occlusion group were worse and 21 per cent of the chemopallidectomy group were worse. Among the latter was 1 patient who appeared to be worse because of an increase of symptoms on the side for which there had been no operation. Three others reported that they were worse in their daily activities, apparently due to an increase of symptoms on both sides of the body.

4. *Effect of fatigue or excitement.* The effect of these stresses on the motor disturbances may be seen in Table 2. It appears that in about one-third of the cases there was total absence of recurrence of tremor or rigidity following fatigue or excitement. In about 40 per cent of cases there was mild recurrence under these conditions.

[2] This indicated normal progression of the disease in those not originally benefited by operation.

TABLE 2

Recurrence of Motor Disturbances Following Fatigue or Excitement

Surgical Group	Recurrence?			Total
	No	Slight	Yes	
Choroidal artery occlusion	6	12	2	20
Chemopallidectomy	10	7	11	28
Total	*16*	*19*	*13*	*48*

TABLE 3

Change During the Three Months Previous to Follow-up Questionnaire

Surgical Group	Better	Same	Slightly Worse	Worse	Total
Anterior choroidal artery occlusion	6	9	5	—	20
Chemopallidectomy	9	10	4	4	27
Total	*15*	*19*	*9*	*4*	*47*

5. *Recent change.* In response to the query, "Has there been a change in your condition during the past three months?" the following information was obtained (Table 3): among 47 patients replying, the largest group (19 patients, or 40 per cent) said their condition was unchanged; 15, or 32 per cent were better; 9, or 19 per cent were slightly worse; and 4, or 9 per cent, were definitely worse.

B. *Non-motor factors*

Answers to the questionnaire revealed the following:

1. *Facial expression.* Although facial expression was not a major consideration in evaluation, improvements in this area seemed to persist. Sixty-nine per cent of the choroidal occlusion group and 58 per cent of the chemopallidectomy group claimed that their facial expression was less masked as a result of the operation. Only 9 per cent of the former group reported that their facial expression was more masked, and 13 per cent of the chemopallidectomy group reported this finding.

2. *Oiliness of the skin.* About 34 per cent of the total group reported a diminution of excessive perspiration and felt that it was due to the operation. Eleven per cent reported that the skin was now too dry.

3. *Nervousness.* Of the total group, 59 per cent stated that they were less nervous than before surgery—more specifically, 65 per cent of the choroidal occlusion group and 55 per cent of the chemopallidectomy group. However, 13 per cent of the former and 24 per cent of the latter group reported that their nervousness has increased.

4. *Speech.* Twenty-nine per cent of the choroidal occlusion group and 21 per cent of the chemopallidectomy group experienced improvement in speech. On the other hand, 29 per cent of the former and 34 per cent of the latter group considered themselves to be worse in this respect. On dividing the cases according

to the side of the brain selected for surgery, it was found that 3 of the 6 patients in the choroidal group occlusion who reported speech to be worse, had had their operations on the left side of the brain. In these instances, the difficulty did not seem to be on the basis of classic asphasia. Rather, it appeared to be an exaggeration of the usual parkinsonian problems such as difficulty in swallowing or phonation. In the chemopallidectomy group, almost all of the patients who thought their speech was worse had had their operations on the left side of the brain. The reasons for the deterioration, if offered, failed to clarify the situation. Two said their speech was slowed down, and some stated that their voice was weaker and more effort was needed to carry on a conversation.

5. *Depression.* The choroidal occlusion group appeared to have improved a little more than the chemopallidectomy group in this sphere. Forty-four per cent of the former and 34 per cent of the latter group reported that they were less depressed; 29 per cent and 31 per cent, respectively, stated that they were more depressed.

6. *Memory.* The choroidal occlusion group reported a somewhat greater degree of memory deficit than did the chemopallidectomy group. Thirteen per cent of the former and 21 per cent of the latter group stated that their memories were better, whereas 44 per cent and 28 per cent, respectively, experienced increased memory deficits. In the choroidal occlusion group, the patients who reported memory losses were divided equally with respect to the side of the brain upon which they had had their operations. In the chemopallidectomy group, among the 8 patients who reported memory loss, 6 had had their operations on the left side of the brain, and 2 on the right side.

7. *Fatigue.* Forty-four per cent of the choroidal occlusion group and 46 per cent of the chemopallidectomy group stated that they grew less fatigued since the operation, whereas 13 per cent of the former and 31 per cent of the latter group reported increased fatigability.

8. *General health.* The majority of subjects in the total group felt healthier in general since undergoing operation. Fifty-eight per cent of both the choroidal occlusion and chemopallidectomy groups reported increases in general health. About eight per cent of the total group rated themselves as worse in this respect

9. *Employment status.* The most striking findings, as listed in Table 4, were:

TABLE 4

Current Vocational Status

	Choroidal Occlusion Group	Chemopallidectomy Group	Total
1. Working now; unemployed before	6	3	9
2. Works better now	1	1	2
3. Worked before; works now	—	3	3
4. Not working before; not working now	13	13	26
5. Works less well now	1	1	2
6. Worked before; not working now	—	3	3
7. Looking for work; sheltered work	1	1	2
Total	*22*	*25*	*47*

TABLE 5

Extent of Contribution to Household Duties

	Choroidal Occlusion Group	Chemopallidectomy Group	Total
1. Does everything; did nothing before	10	5	15
2. Does more things	—	4	4
3. Does things—same	—	7	7
4. Does nothing—same	11	6	17
5. Does fewer things	2	2	4
6. Does nothing; used to do something	—	—	—
Total	*23*	*24*	*47*

1) most patients were unemployed before operation and were still unemployed (in almost every instance the reasons given for the unemployment were a complex product of psychologic as well as physical factors), 2) about a fifth of the patients who had not been working before operation, were now gainfully employed, 3) only about a fifth of the patients were employed prior to the operation, whereas more than a third were at work or in the employment market at the time of the questionnaire.

10. *Household activities.* The question in this category was, "Do you help in household activities other than self-care?"

The most pertinent findings, as shown in Table 5, were: 1) in the total group, 32 per cent who had not been able to contribute to the household routine preoperatively were now able to do so, 2) 35 per cent who contributed little before operation still contributed little, 3) only 9 per cent did less, and 4) the choroidal occlusion group demonstrated the greater gain in the area of household duties.

C. *Attitudes related to surgery*

1. *Preoperative expectations regarding surgery.* The responses to the question "What did you expect from the operation before it was performed?" were tabulated in three categories: 1) relief of parkinsonian symptoms such as tremor, rigidity, speech disturbances, 2) gains in functional skills, *e.g.*, walking, and 3) complex, less defined, or personal goals, *e.g.*, represented by such answers as "I wanted a complete cure," or "I wanted to be a man again."

The results indicated that 30 to 40 per cent wanted specific relief of parkinsonian symptoms, and an additional 30 to 40 per cent hoped for a return of functional skills. From 25 to 30 per cent aspired to goals which were less directly concerned with the actual intent of the surgery.

2. *Satisfaction with the results of operation.* When the patients were asked to comment about their attitudes towards the results of the surgery, the following information was noted (Table 6):

Approximately 41 per cent of the total group said they were completely satisfied with the operative result (39 per cent of choroidal occlusion group, and 43 per cent of the chemopallidectomy group). Slightly more than a fourth of the patients qualified their responses in some way. The remainder (about 31 per

TABLE 6

Satisfaction with the Results of Operation

Surgical Procedure	Completely Satisfied	Partially Satisfied	Dissatisfied	Total
Anterior choroidal artery occlusion	9	7	7	23
Chemopallidectomy	12	7	9	28
Total	*21*	*14*	*16*	*51*

TABLE 7

Willingness to Undergo the Same Surgical Procedure Again

Surgical Procedure	Yes	No	Don't know	Total
Anterior choroidal artery occlusion	15	7	—	22
Chemopallidectomy	24	1	3	28
Total	*39*	*8*	*3*	*50*

cent) were disappointed with the outcome. The degree of satisfaction is a complex state which is a product of the original level of aspiration and the actual results. The higher the level of aspiration, the less the satisfaction, regardless of the actual results.

3. *Willingness to undergo the same surgical procedure again.* When patients were asked if they would be willing to undergo the same operation if the conditions were exactly the same, the following information was obtained (Table 7):

Seventy-eight per cent of the total group would undergo the operation again. Sixty-eight per cent of the choroidal occlusion group and 86 per cent of the chemopallidectomy group held this opinion. Thirty-two per cent of the former and 4 per cent of the latter group were not willing to undergo the procedure again.

DISCUSSION

Our interpretation of these results is qualified by several important factors which make the problem of evaluation somewhat complicated. Practically all of the patients were in the advanced stages of Parkinson's disease at the time of operation. They had been ill for an average of ten years and there was consequent debilitation in social, vocational, physiologic, and psychologic areas. Thus some symptomatic improvement may have been masked by continued debilitation in other areas. The operation was unilateral, and even when successful could not be expected to arrest the stigmata of the disease on the untreated side of the body. In view of these factors the large number of reported good results is even more impressive than appears at first glance.

What conclusions can we draw from our data? The most important one is that *the effects of the operation in relieving tremor and rigidity are lasting within the time limits under consideration in this study.* The slight difference in the incidence of improvement as compared with the data of the earlier postoperative cases can be explained by sampling differences as well as fallibility in the measure-

ment techniques. At any rate, the evaluations recorded in the study we made of patients at the time of discharge from the hospital do not differ significantly from those recorded in this survey. The reduction in the primary motor symptoms is translated to some extent into an increase in functional activities, in the sense that patients are helped in carrying out the activities of daily living in a more independent fashion, being able to perform useful functions in regard to household chores, and even returning to work.

In the non-motor areas of functioning it was observed that the operation helps parkinsonian patients troubled by masked facies and excessive perspiration. Another by-product of the relief of tremor and rigidity is the decline in nervousness.

Some patients experience improvement with respect to depression and disturbances of speech and memory. However these gains are offset by the fact that a slightly larger number of patients claim increasing difficulties in speech and memory, and a large number are more depressed. Are these effects due to the increased inroads of a disease which has been partially halted by unilateral neurosurgical procedure, or are they due to the surgery itself? This question can not be answered without a control group or a more detailed clinical study. There is some evidence that both factors may play a role.

Usually there is a decided improvement in general health following operation, and a tendency toward less fatigue.

Some qualitative observations offered by the patients should be noted at this point. 1) Several patients reported an increase in sexual activity. Their spouses reported that patients had resumed sexual activities after years of abstinence. In 2 instances the change in sexual status led to such a drastic revision of marital roles that familial discord ensued. These cases illustrate the profound effects of a major change in a physical disease on people who have become accustomed to live with the constraints of a debilitating illness. In this context, it is noteworthy that many patients reported satisfaction with changes in sexual status. In fact one man who had suffered from Parkinson's disease for nearly eighteen years, and who had given up hope of marriage, reported that three years after the operation he was happily married and the father of a child. 2) More than a fourth of the patients reported significant gains in weight. 3) Several patients reported some diminution in "drive" or initiative.

SUMMARY

Detailed questionnaires were mailed to 27 parkinsonian patients who had undergone anterior choroidal artery occlusion, and to 37 who had undergone subtemporal chemopallidectomy. For the former group, the time that had elapsed since operation ranged from eighteen to thirty-six months; for the latter group, from nine to thirteen months. Of the total group, 85 per cent responded directly or through their families. The questionnaire required information in regard to the symptoms, daily activities, vocational problems, and over-all adjustment.

Analysis of the results revealed improvement of tremor and rigidity in more

than two-thirds of the total group, and improvement in performance of the activities of daily living in about three-fifths. Marked changes were noted in many areas of life adjustment. The great majority of patients stated that they would be willing to undergo operation again under the same circumstances. The conclusion is that tremor and rigidity can be improved through neurosurgery without sacrifice of motor power. This improvement is lasting, within the time limits under consideration.

REFERENCES

1. Diller, L.; Riklan, M., and Laszewski, Z.: Effects of anterior choroidal artery occlusion and of chemopallidectomy on the tremor and rigidity of Parkinson's disease: an independent appraisal, *J. Am. Geriatrics Soc.* **4:** 1246–1248 (Dec.) 1956.
2. Cooper, I. S.: Surgical alleviation of parkinsonism: effects of occlusion of the anterior choroidal artery, *J. Am. Geriatrics Soc.* **2:** 691–718 (Nov.) 1954.
3. Cooper, I. S.: Chemopallidectomy: an investigative technique in geriatric parkinsonians, *Science* **121:** 217–218, (Feb.) 1955.
4. Cooper, I. S.; Poloukhine, N., and Morello, A.: Surgical alleviation of parkinsonism, *J. A. M. A.* **160:** 1444–1447 (Apr. 28) 1956.

CERTAIN PSYCHOMOTOR ASPECTS OF SUBTEMPORAL CHEMOPALLIDECTOMY FOR PARKINSON'S DISEASE

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The large variety of motor symptoms found in parkinsonism makes both preoperative and postoperative evaluation a rather complex process. Much effort has therefore been devoted to establishing methods and techniques which would provide an intensive yet practical means of appraising surgical outcome. Earlier evaluations were based primarily on clinical impressions made by the surgical and medical staff, and on the patient's subjective statements in regard to his postoperative condition. We have reported elsewhere in this symposium the results of a statistical analysis of preoperative and postoperative ratings with regard to tremor and rigidity (1).

In considering different ways of determining preoperative and postoperative motor function in a more objective and precise manner, it was decided to experiment with certain basic psychomotor tests. It was felt that some tests previously used in psychologic laboratories for the appraisal of motor and learning skills, properly selected, might be appropriate in evaluating certain of the motor symptoms found in parkinsonism. Psychomotor tests of this nature have been utilized in the past by other investigators in this area (2, 3, 4). Use of these tests, however, has been primarily in the estimation of the effects of drug therapy. The field of psychomotor testing and its theoretical aspects has long been explored by the experimental psychologists. Fleishman (5), in a recent review of the literature of psychomotor testing and evaluation, lists ten factors which seem to underline most aspects of psychomotor functioning. These include reaction time, tapping ability, steadiness, psychomotor coordination, and manual dexterity. Dozens of commercial tests are available for the measurement and appraisal of each of these factors.

The problem in selecting the appropriate instruments for studying parkinsonian symptoms before and after neurosurgery is complicated by the fact that the patient: 1) usually demonstrates involvement in several psychomotor areas simultaneously, and 2) the tests are designed to determine factors underlying motor skills, rather than to describe anomalies of human movement. However, certain basic motor skills appear closely related to the symptoms of parkinsonism. In the selection of the appropriate psychomotor tests, therefore, it was necessary to choose those which most approximated the motor skills affected in the symptoms of the illness. In addition, it was felt that an intensive evaluation should be made of the functional activities which these skills involve.

PROCEDURE

Four tests were selected, one for the estimation of functional activities, and three for the measurement of certain basic motor skills. The instruments, methods of administration, and the factors involved were as follows:

1. *Activities of daily living.* The scale consisted of 98 items of functional ac-

tivities of daily living, including ambulation, dressing, feeding, toilet, and hand activities (Appendix A). Each patient was rated regarding each of these items on the basis of whether he was unable to perform the activity (1 point), could perform it with assistance (2 points), or could perform it independently (3 points). The test was administered preoperatively and postoperatively by an experienced physical therapist. The score was the number of points on each scale.

2. *Steadiness.* This was measured by a test which consisted of a brass plate measuring 4 by 2½ inches, containing on its face nine holes of diameters ranging from ½ to 3/32 inch. Only the holes with diameters of ½, ¼ and 5/32 inch were used. The task of the subject was to insert and hold a metal stylus in each hole for a standard length of time without permitting contact. The apparatus was electrically wired so that each time the stylus came in contact with the side of the hole the fact was registered on an automatic counter. The subject's score was the number of contacts the stylus made with the side of the hole, in a 15-second time-period. Six trials were administered for each hand, preoperatively and postoperatively.

3. *Speed of movement.* This was measured by a tapping test, in which the Whipple tapping board was used. This is a standard psychomotor apparatus consisting of a wooden base measuring 21½ by 4 inches, having on each end a metal plate measuring 4 by 4 inches. The metal plates are 13½ inches apart. The subject was provided with a metal stylus and his task was to tap as rapidly as possible, alternating between metal plates. The apparatus was electrically wired so that the number of taps was automatically recorded on a counter. The patient's score on this test was the number of taps in a 20-second time-period. Six trials were administered for each hand, preoperatively and postoperatively.

4. *Manual dexterity.* For this measurement, the Minnesota Rate of Manipulation test was employed. The apparatus consists of a board measuring 34 by 9½ inches and containing 60 holes, each approximately 1½ inches in diameter. Sixty circular blocks are provided. The patient's task was to replace each block in a hole according to a regular procedure, at his maximum rate of speed. His score was the time it took him to replace sixty blocks in the board. The test was administered three times for each hand, preoperatively and postoperatively.

Because the symptomatology in parkinsonism may vary under different situations of emotion and stress (6), utmost care was taken to assure reliable scores. For each motor-skill test, from three to six trials were made and mean scores were used in the statistical analysis. Patients were tested by the same examiner, in the same setting, both before and after operation, and medication was kept uniform whenever possible. Furthermore, since each patient was evaluated both preoperatively and postoperatively for both hands, and the operation was unilateral in nature, two further sources of experimental control were available. The patient in effect served as his own control both preoperatively and postoperatively, and one hand served as a control for the other.

The subjects selected for this intensive psychomotor appraisal were 22 consecutive parkinsonian patients undergoing subtemporal chemopallidectomy. The group consisted of 14 men and 8 women whose ages ranged from 36 to 67,

TABLE 1

Statistical Analysis of Preoperative and Postoperative Differences in Scores (Mean Values) for Performance of Activities of Daily Living

Response to test	Preop. Mean	Postop. Mean	Diff. between Means, *t*	Significance, *P*
Unable to perform activity	14.8	15.2	.009	.9
Performs with assistance	22.7	9.4	2.86	.01
Performs independently	60.2	72.9	2.23	.05
Total score	*241.0*	*253.1*	.79	.5

TABLE 2

Statistical Analysis of Preoperative and Postoperative Scores (Mean Values) for Steadiness, Speed of Tapping and Manual Dexterity on Surgically Treated Side Compared with Untreated Side

Psychomotor Test	Preop. Mean	Postop. Mean	Diff. between Means, *t*	Significance, *P*
Steadiness (¼-inch hole)				
Surgical side	23.4	12.3	3.21	.01
Non-surgical side	11.9	11.6	.77	.5
Tapping Speed				
Surgical side	25.0	33.9	2.80	.01
Non-surgical side	32.9	33.7	.59	.6
Manual Dexterity				
Surgical Side	191.9	145.8	2.06	.1
Non-surgical Side	136.9	134.4	.49	.8

with a mean age of 46.2 years. The length of illness ranged from 2.3 years to 33 years, with a mean length of 11.4 years. The patients were evaluated approximately one week before surgery, and again approximately six weeks after surgery.

RESULTS

A Pearson Product Moment Coefficient of Correlation was computed for each of the tests. For the activities of daily living scale, it was based upon the results in 10 cases in which the test was administered separately by two experienced physical therapists. The reliability was .74. This is significant at the .01 level of confidence. The reliabilities of the remaining three tests were determined by the split-half method, and ranged from .73 for the manual dexterity test, to .93 for the speed-of-tapping test—in all cases significant at the .01 level of confidence.

In Table 1 are summarized the preoperative and postoperative means for the activities of daily living scale. The differences between means were evaluated by *t* tests (7).

As may be seen in the table, the subscales, "performs with assistance" and "performs independently" demonstrated statistically significant changes in a positive direction. More detailed analysis indicated that the decrease in scores on the "performs with assistance" scale was usually accompanied by an increase

in the "performs independently" scale. A more complete picture of the extent of the changes may be gained by noting that 4 patients who were unable to perform at least one item preoperatively were able to perform all tasks at least with assistance postoperatively; and 4 other patients who preoperatively needed assistance in at least one task, no longer needed it postoperatively.

The preoperative and postoperative findings in regard to steadiness, speed of tapping, and manual dexterity are recorded in Table 2.

In regard to steadiness and speed of tapping, the difference between preoperative and postoperative functioning on the side affected by the operation was significant at the .01 level. In the case of manual dexterity, as estimated by the placing part of the Minnesota Rate of Manipulation Test, the improvement was less marked, although still in a positive direction. The findings for the side not treated surgically revealed no significant changes; in fact these findings were almost identical before and after surgery, indicating that the results on the side affected by the operation were not due to a practice effect.

DISCUSSION

In utilizing standard or conventional psychomotor tests for the evaluation of preoperative and postoperative motor symptoms in parkinsonism, the problem must, in a sense, be approached in an indirect manner. For example, measurement is made of the motor skill involved rather than of the symptom. Since the symptoms of parkinsonism include numerous aspects of motor functioning (8), the task in this investigation was to select those available psychomotor tests which appeared to be most closely related to the major symptoms of the disease. The steadiness test was chosen because of its evident inverse relationship to the symptoms of tremor. The speed-of-tapping and manual dexterity tests were selected in order to appraise the combined symptoms of rigidity, paralysis, bradykinesia and akinesia. The behavioral effect of this group of symptoms is to slow and impair movement and interfere with manual dexterity. Taken together, therefore, these two motor tests could be expected to provide a gross, though objective, means of evaluating these symptoms.

Since the motor deficits in parkinsonism also serve to interfere with a patient's ability to carry out the activities of daily living, it was felt that they should be included in the objective analysis. With improvement in motor symptoms, concomitant improvement in the activities of daily living would be anticipated. This was found to be true, although the over-all score for the activities of daily living did not change significantly. The latter finding may be due to the fact that activities of daily living are a function of non-motor factors such as drive, motivation, and initiative, all of which could interfere with, or mitigate improvement in that area. In addition many of the items involved the use of both sides of the body.

Our data pose a general problem with regard to current psychologic theories. Current views suggest that motor skills are reflections of personality. Defects in motor skills have been alleged to be the most sensitive measures of defects in personality integration (9). One wonders how this generalization stands up in

the light of our data. Our patients postoperatively had fewer defects in motor skills, thus making it doubtful that a basic change in central ideational processes had occurred. Moreover, our findings were basically concerned with only unilateral changes in motor skills. Postoperatively many of the patients still demonstrate defective motor skills on one side of the body. How does the theory account for this state of affairs? Our observations therefore suggest that current theories are limited to one order of data derived from the field of mental disease. We suggest that the theories be broadened to include data such as ours derived from a study of neurologic disease.

SUMMARY

Twenty-two consecutive parkinsonian patients undergoing subtemporal chemopallidectomy were selected for intensive psychomotor investigation. They were subjected to a series of motor tests approximately one week preoperatively, and six weeks postoperatively. The series consisted of a 98-item scale concerned with the activities of daily living, a steadiness test, a speed-of-tapping test, and a manual dexterity test. They were selected on the basis of their relationship to the symptoms of Parkinson's disease.

Tabulated results indicated that, with respect to the steadiness and speed tests, the side of the body affected by the pallidectomy demonstrated statistically significant improvement at the .01 level of significance. For the manual dexterity test, the improvement was in a positive direction, but not to a statistically significant degree. The scale for activities of daily living, although revealing no increase in the over-all rating, did indicate an increase in the ability to perform activities independently and a decrease in the necessity to obtain help in performing them. Other evidence suggested that there were improvements in performance of the activities of daily living which were not reflected in the statistics.

REFERENCES

1. Diller, L.; Riklan, M. and Laszewski, Z.: Effects of anterior choroidal artery occlusion and of chemopallidectomy on the tremor and rigidity of Parkinson's disease: an independent appraisal, *J. Am. Geriatrics Soc.* **4:** 1246–1248 (Dec.) 1956.
2. Schwab, R. S., and Prichard, J. S.: An assessment of therapy in Parkinson's disease, *Arch. Neurol. & Psychiat.* **65:** 489–501 (Apr.) 1951.
3. Askar, A. M.: A method for the quantitative estimation of drugs on parkinsonism, *J. Egyptian Med. A.* **37:** (4) 351–377, 1954.
4. Kaplan, H. A.; Machover, S., and Rabiner, A.: A study of the effectiveness of drug therapy in parkinsonism, *J. Nerv. & Ment. Dis.* **119:** 398–411 (May) 1954.
5. Fleishman, E. A.: Testing for psychomotor abilities by means of apparatus tests, *Psycholog. Bull.*, **50:** 241–262 (July) 1953.
6. Schwab, R. S., and Prichard, J. S.: Situational stresses and extrapyramidal disease in different personalities, *in* Life Stress and Bodily Disease. Research Publ. Assoc. Nerv. & Ment. Dis. Baltimore, The Williams & Wilkins Co., 1950, vol. 29, pp. 48–60.
7. Edwards, A. L.: Experimental Design in Psychological Research. New York, Rinehart & Co., 1950, p. 407.
8. Wilson, S. A. K., and Bruce, N. A.: Neurology. ed. 2. Baltimore, Williams and Wilkins Co., 1955, vol. II.
9. King, H. E.: Psychomotor Aspects of Mental Disease. Cambridge, Mass., Harvard Univ. Press, 1955.

Appendix A

Parkinson Research Project

Gross Motor Skills Evaluation Scale

Physical Demands of Daily Life

Name_____ Date of Evaluation_____

Address_____ Sex_____ Age_____

_____ Oper. Date_____ Side of Oper._____

Instructions for Recording

Each of the activities listed on the following pages are to be rated according to the following criteria:

I. Unable to Perform Activity

A. If the patient cannot perform any part of a given activity, he needs:

1. Lifting, if the activity involves transfer of entire body weight from one place to another, *e.g.*, transfer from bed to chair.
2. Somebody to do the activity for him, *e.g.*, feeding, combing hair, tying shoelaces, etc.

II. Performs with Assistance

A. If the patient can perform part of a given activity he needs assistance which may consist of:

1. Finishing the activity for him, *e.g.*, he may be able to eat part of a meal; lift one leg up on the bed but not the other.
2. Some kind of support, *e.g.*, when sitting up in bed, or when getting up from a chair.
3. Standing by—until he is completely sure of himself (safe) when doing a given activity.

III. Performs Independently

A. The patient is completely independent. This means he can perform the activity all by himself, in a reasonable amount of time and repeat as often as it would be necessary (without becoming exhausted) in a real life situation, *e.g.*, standing up and sitting down, as necessary in an office or at home.

	Unable to Perform Activity	Performs with Assistance	Performs Independently
I. *Non-walking Activities*			
A. *Bed Activities*			
1. Moving from place to place in bed	____	____	____
2. Roll to right and then to left side	____	____	____
3. Sitting erect in bed	____	____	____
4. Turning from back to abdomen in bed	____	____	____
5. Procure objects from night table	____	____	____
B. *Hygiene* (toilet activities)			
1. Combing or brushing hair	____	____	____
2. Brushing teeth	____	____	____
3. Shaving or putting on cosmetics	____	____	____
4. Washing hands and face	____	____	____
5. Washing extremities	____	____	____
6. Manipulating bed-pan	____	____	____
7. Applying urinal/special pants	____	____	____
8. Taking shower	____	____	____
9. Tub bath	____	____	____
10. Ability to dry self after shower or bath	____	____	____
11. Adjusting clothing for toilet needs	____	____	____

	Unable to Perform Activity	Performs with Assistance	Performs Indpened-ently
C. *Eating Activities*			
1. Cutting meat	___	___	___
2. Buttering bread	___	___	___
3. Eating for fork	___	___	___
4. Eating with teaspoon, tablespoon	___	___	___
5. Drinking from glass	___	___	___
6. Drinking from cup	___	___	___
7. Stirring coffee, tea, etc.	___	___	___
D. *Dressing and Undressing Activities*			
1. Put on underclothes	___	___	___
2. Remove underclothes	___	___	___
3. Put on buttoned shirt (zipper)	___	___	___
4. Remove buttoned shirt	___	___	___
5. Put on slip-over garment	___	___	___
6. Remove slip-over garment	___	___	___
7. Put on slacks	___	___	___
8. Remove slacks	___	___	___
9. Tie shoes (buckle, zipper)	___	___	___
10. Tying tie	___	___	___
11. Put on hose	___	___	___
12. Remove hose	___	___	___
13. Put on overcoat	___	___	___
14. Remove overcoat	___	___	___
E. *Hand Activities*			
1. Write name and address	___	___	___
2. Fold letter, place in envelope, seal envelope	___	___	___
3. Open envelope, remove letter	___	___	___
4. Use dial telephone	___	___	___
5. Turn pages of book	___	___	___
6. Wind wrist watch	___	___	___
7. Open and close cylinder lock	___	___	___
8. Open and close ice box door	___	___	___
9. Open and close door lock with key	___	___	___
10. Open and close drawers	___	___	___
11. Open and close door locks	___	___	___
12. Open and close window	___	___	___
13. Pull window shade	___	___	___
14. Push door bell	___	___	___
15. Use workshop switch	___	___	___
16. Use work plug switch	___	___	___
17. Use work push button	___	___	___
18. Work key light switch	___	___	___
19. Work pull chain light	___	___	___
20. Ring door bell	___	___	___
21. Open and close cabinet lock	___	___	___
22. Turn four-pronged faucet	___	___	___
23. Turn circular faucet	___	___	___
24. Open and close medicine chest	___	___	___
25. Open and close bottle	___	___	___
26. Open and close safety pin	___	___	___
27. Strike match	___	___	___
28. Cut with scissors	___	___	___

	Unable to Perform Activity	Performs with Assistance	Performs Independently
F. *Elevation Activities*			
1. Bed to erect position	___	___	___
2. Erect position to bed	___	___	___
3. Chair to erect position	___	___	___
4. Erect position to chair	___	___	___
5. Erect position to chair at table	___	___	___
6. Chair at table to erect position	___	___	___
7. Upholstered chair an/or sofa to erect position	___	___	___
8. Erect position to upholstered chair or sofa	___	___	___
9. Erect position to toilet	___	___	___
10. Toilet to erect position	___	___	___
11. Down to floor	___	___	___
12. Up to floor	___	___	___
13. Bend to pick object off floor	___	___	___
II. *Walking Activities*			
G. *Progressing Activities*			
1. Walking forward 15 feet	___	___	___
2. Walking forward 30 feet	___	___	___
3. Walking backward 15 feet	___	___	___
4. Walking backward 30 feet	___	___	___
5. Walking sidward 15 feet	___	___	___
6. Opening and closing door, passing through and return	___	___	___
H. *Climbing Activities*			
1. Up 15 degree ramp, 3 feet	___	___	___
2. Down 15 degree ramp, 3 feet	___	___	___
3. Up 6 standard steps, one hand rail	___	___	___
4. Down 6 standard steps, one hand rail	___	___	___
5. Up 6 standard steps, no hand rail	___	___	___
6. Down 6 standard steps, no hand rail	___	___	___
7. Up and down one flight of stairs, one hand rail	___	___	___
8. Up and down one fiight of staris, no hand rail	___	___	___
9. Up a 4″ curb	___	___	___
10. Up a 6″ curb	___	___	___
11. Up an 8″ curb	___	___	___
12. Down a 4″ curb	___	___	___
13. Down a 6″ curb	___	___	___
14. Down an 8″ curb	___	___	___

ELECTROMYOGRAPHIC STUDIES OF TREMOR IN PARKINSON'S DISEASE, BEFORE AND AFTER CHEMOPALLIDECTOMY

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Electromyographic findings in Parkinson's disease should be regarded only as an index of some of the disturbances of function of the neuromuscular system. They provide objective information for evaluation of the clinical problem and of the effects of therapy, whether medical or surgical. This form of investigation should be carried out in such a way that the recordings are reproducible when a follow-up study is contemplated.

Obviously the general attitude of the patient cannot be expressed in terms of electromyographic potentials. The facial immobility, the position of the arms (abducted at the shoulders and flexed at the elbows), the stooping attitude and the change in posture are typical symptoms of the neurologic disorder. They cannot be expressed by electrical potentials. The propulsion, festinating gait, kinesia paradoxa and general slowness cannot be translated in terms of action potentials. However, electromyographic studies can be made of certain other symptoms, such as tremor, rigidity, and the cogwheel sign. In this paper we shall report only some of our observations concerning tremor.

Among the different techniques used for the recording of tremor, electromyography is the most valuable one. Tambours and levers have been used, as well as other types of instruments. Study of the action potential is interesting, because it represents the actual firing of the different motor units involved in a given motion. In addition, it can furnish some information about the conditions of the muscles between the active discharges. Numerous papers have been written on the subject of electromyography in Parkinson's disease; they will not be reviewed here.

TECHNIQUE

A multiple-channel ink-writing oscillograph, as used for electroencephalographic recording, can be useful. In that case, either surface (skin) or co-axial needle electrodes are employed. Surface electrodes can provide some information about the general disturbance of muscles, showing more or less the envelopes of the action potentials, but precautions have to be taken not to record potentials from far distant muscles. Co-axial needle electrodes are better than skin electrodes. With the ink-writer technique, one loses a great many details and valuable information.

In the present work we usually employed a dual-beam cathode-ray oscilloscope with a high-gain preamplifier and audioamplifier. Recordings were made on 35-mm. film with a moving picture camera of variable speeds. A second oscilloscope was used as a monitor. When only one muscle was studied, the second channel was fed by a time signal. Both beams were used to record simultaneously, either from two different muscles or from two different areas in the same muscle. The speed of the camera varied between 10 cm. per second and 25–50 cm. per second.

Concentric needle electrodes from a 25-gauge needle were inserted into the muscles. These were used in preference to monopolar electrodes. One of the difficulties was to keep the needle in a steady position, as in some cases the involuntary motion was violent; the recording therefore can sometimes be complicated by the artefact motions of the needle. One of the objects of the present work was to study tremor in Parkinson's disease prior to chemopallidectomy and to record action potentials following this operation.

TREMOR

In Parkinson's disease, tremor consists of alternating contractions of agonist and antagonist muscles. The bursts of impulses are rhythmic and regular. The frequency seems to vary only slightly in the same patient. The intensity can increase tremendously with emotional stimuli or when the patient can be distracted from his malady. The to-and-fro movements are the results of alternating contractions of groups of muscles functionally associated. The movements are not "purposeless," as in some other involuntary muscular disorders; the motions are well coordinated. Clinical analysis is sometimes difficult, because the tremor is not always a simple movement. Alternating contractions of flexors and extensors can be combined with motions of pronation-supination, or adduction-abduction. The different components of the movements can sometimes be broken down by moving-picture studies, using slow motions.

There are often no apparent signs of fatigue, in spite of the tremulous disturbance in function. When the electromyographic recordings are made, the patient is fixed in the most comfortable position possible, either sitting with his arm resting on a table or in the supine position on a bed. Some of our studies required one or two hours of recording. Frequently the patient was requested to try not to stop his tremor—which he instinctively tends to do—whereupon he demonstrated obvious fatigue, even to the point of exhaustion. This is in contrast with what is usually observed in a patient with pure rigidity. The latter patients do not express any definite fatigue, even when longer tests are performed. It was therefore our impression that if the parkinsonian patient frequently attempts to stop the involuntary motion, it is not only because the tremor is a very troublesome symptom, but also because exhaustion occurs when the jerks become more violent.

At the onset of the disease, tremor is more noticeable or more definitely developed in the distal parts of the limbs. The rhythm can vary between 3 and 9 per second, but the average is about 5 per second. Tremors start in the muscles of the thumb and index finger, resulting in a pill-rolling movement. All the intrinsic muscles of the hand can show rhythmic alternating motion. This can develop into an alternating motion which affects flexion and extension of the fingers and wrist. With increase in violence, the forearms and arms may exhibit drum-beating movements. Tremor can be so violent that it is transmitted to the head. As a rule, there is no tremor of the head itself. Rhythmic motions of the mandibular muscles and of the muscles of the lips and chin can be pronounced. There may be rhythmic opening and closing of the mouth; in that case the pa-

tient tends to keep his mouth slightly open. Tremor of the eyelids appears more easily when the eyes are slightly closed, as if it originates only when the levator palpabrae are relaxed. Rhythmic motions of the tongue are also seen.

Frequently the involuntary motions start in one upper extremity, and spread to the homolateral lower extremity. In some cases they start in a lower extremity. There may be rhythmic motions of the foot, resulting in the tapping phenomenon.

RESULTS

Electromyographic recordings were made in over 30 cases; 10 were studied before and after chemopallidectomy. Only 1 case is reported in detail here.

Mrs. O.B.Q. was a 59-year-old woman. The first symptom of parkinsonism had been noticed by the patient two and half years previously. This was tremor of the index finger and thumb of the left hand. At that time, according to the patient, the tremor appeared only under some emotional or physical strain. A year later it had spread over the entire left upper extremity and became violent. She noticed some stiffness and slowness of movement in both arms. There had been no evidence of tremor on the right side. She was admitted to the hospital for evaluation and eventual surgery.

There was pronounced tremor of the left upper extremity, which at times became severe. There was also a marked tremor in the left lower extremity, and foot tapping. She presented the usual mask-like facies, and typical bradykinesia. There was a pronounced cog-wheel sign at the left wrist and left elbow. Speech was monotonous. The autonomic system did not appear to be affected; she did not complain of sialorrhea or oiliness of the skin. Neurologic examination did not reveal any pathologic conditions, aside from Parkinson's disease. Convergence was good. There was no past history of encephalitis. It was felt that the patient was a suitable candidate for a right chemopallidectomy.

Tremor of some of the muscles of the left upper extremity was studied by means of electromyography before surgery. As seen in Figure 1, rhythmic discharges, at the rate of 5 per second, were recorded from the left extensor communis. Bursts of action potentials were interrupted by electrical inactivity. The rhythm was extremely regular. Figure 1-B represents a faster recording; details were clearer but the number of motor unit discharges was so great that individual units could not be analyzed. The amplification was the same as in Figure 1-A; tremor was more intense but the rhythm remained unchanged. Figure 2 shows the simultaneous recordings of two antagonist muscles: the left extensor carpi radialis brevis and the left flexor carpi radialis. Alternating motion with reciprocal innervation is seen. Figure 3 shows single motor unit discharges. The needle was in a favorable position for its recording of one unit. The rhythm was much the same as that of the tremor shown in Figure 1-B.

The patient underwent *right chemopallidectomy*.

In Figure 4 the electromyographic recording of a voluntary contraction of the left extensor digitorium communis, made four days after operation, shows normal electrical activity, indicative of good strength. There was no evidence of any deficit in motor function. There were no surgical complications, and no pathologic reflexes or symptoms. Figure 1-C (four weeks after operation) shows absence of electrical activity at rest in the left extensor communis, indicating that the tremor had completely disappeared. Figure 2-B (four weeks after operation) also shows absence of electrical potential at rest; activities of the left extensor carpi radialis brevis and flexor carpi radialis were simultaneously recorded; tremor had disappeared. In this case there was a dramatic change.

The patient will be followed and further studies will be made in order to find out whether or not the good results are permanent. Some other patients were tested a year or more after surgical intervention. So far, they show similar improvement. In all these patients, however, a long follow-up period is required.

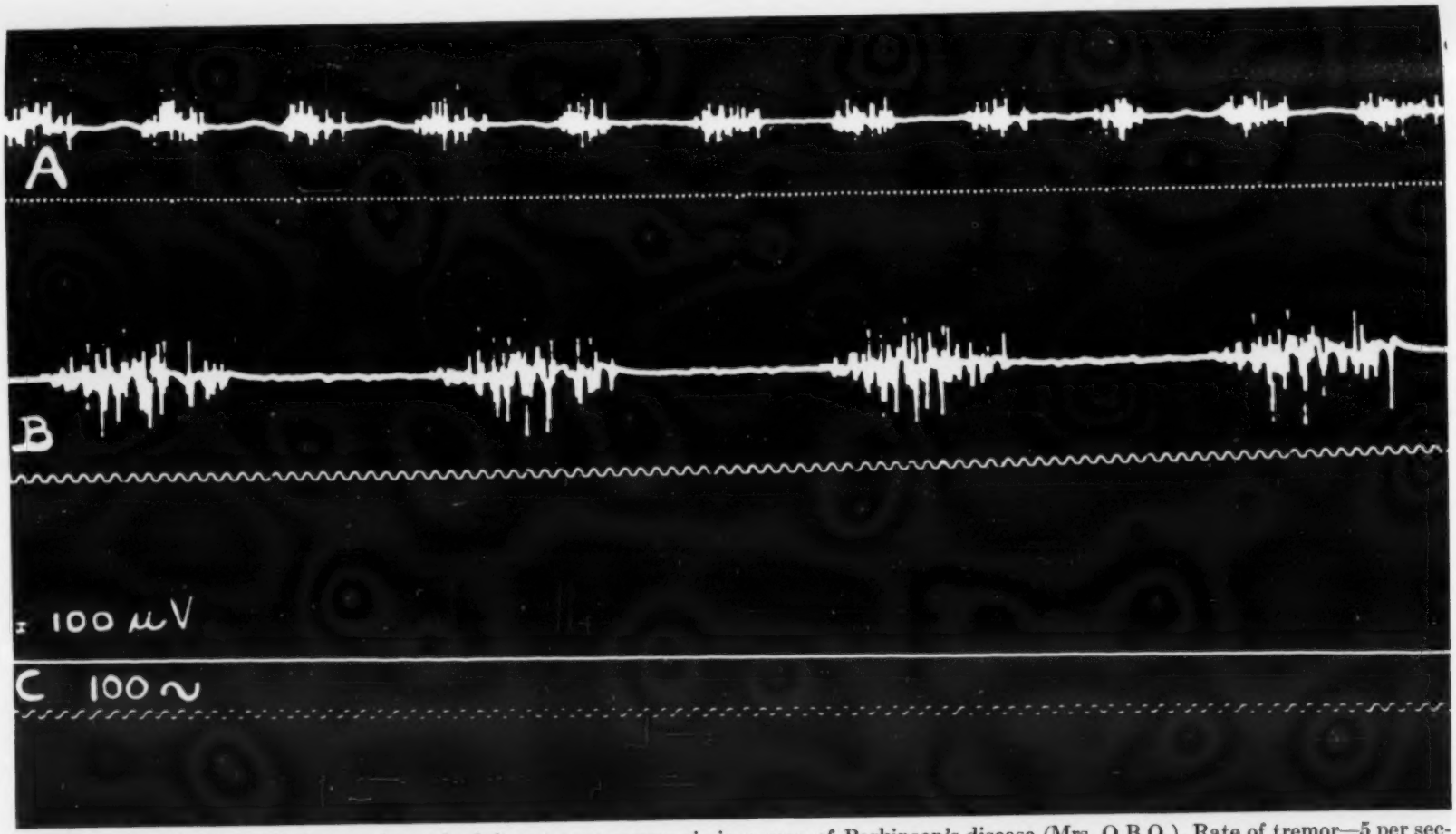

FIG. 1. A. Rhythmic discharges from the left extensor communis in a case of Parkinson's disease (Mrs. O.B.Q.). Rate of tremor—5 per second. Time—100 cycles per second. B. Faster recording (same muscle), to show more details of the electrical potentials. Amplification was the same as in A. Tremor had same rhythm, but was more intense. C. Recording (same muscle) made one month after right chemopallidectomy, showing complete electrical inactivity; no tremor or potential was recorded with the patient at rest (same amplification as in A and B.)

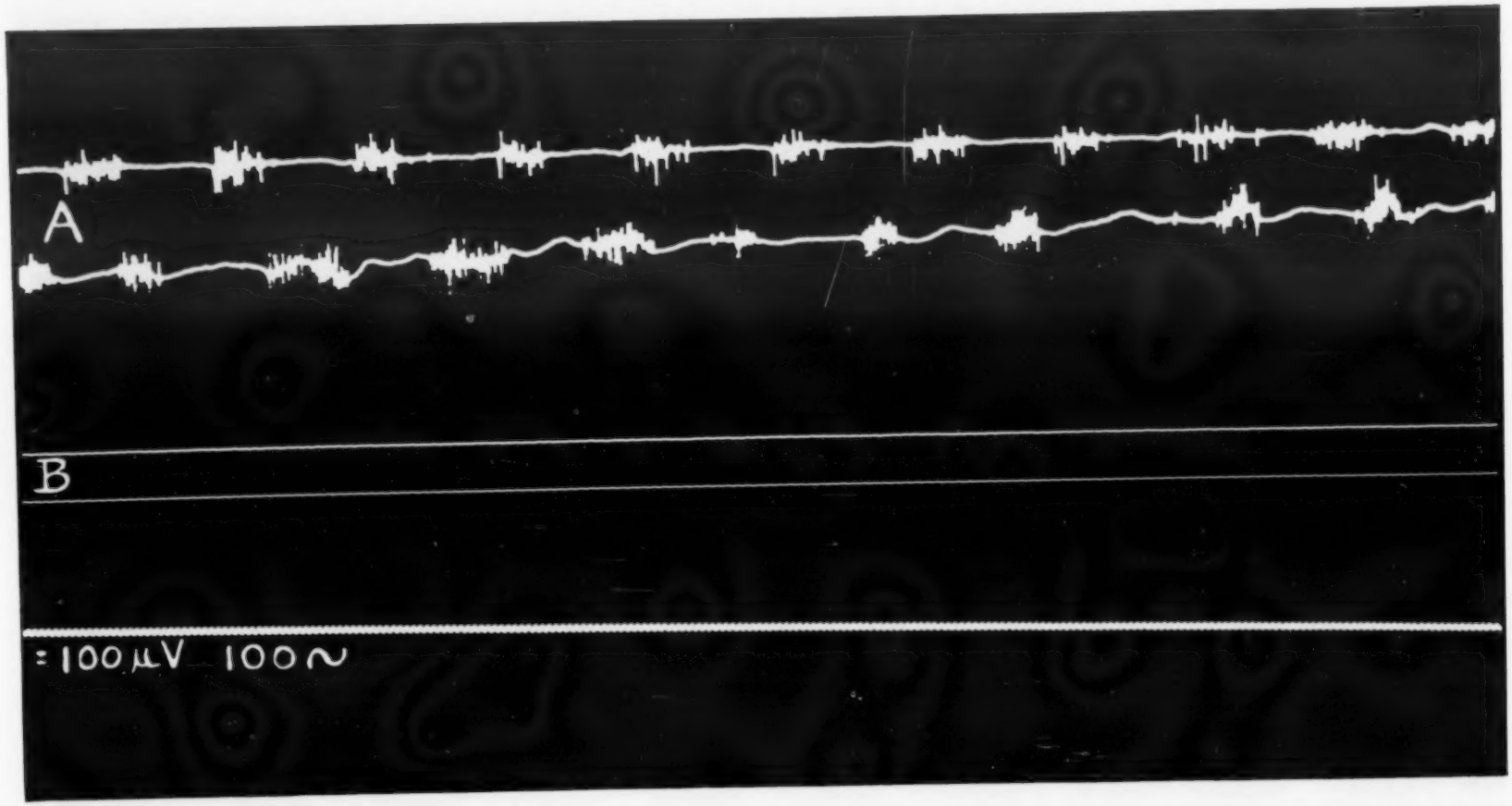

FIG. 2. (Mrs. O.B.Q.). A. Simultaneous recording of two antagonist muscles, showing alternating tremor and reciprocal innervation. Upper record: left extensor carpi radialis brevis. Lower record: left flexor carpi radialis. Time—100 cycles per second. B. Recordings (same muscles) made one month after right chemopallidectomy, showing absence of electrical potentials at rest.

One month after right chemopallidectomy, showing absence of electrical potentials at rest.

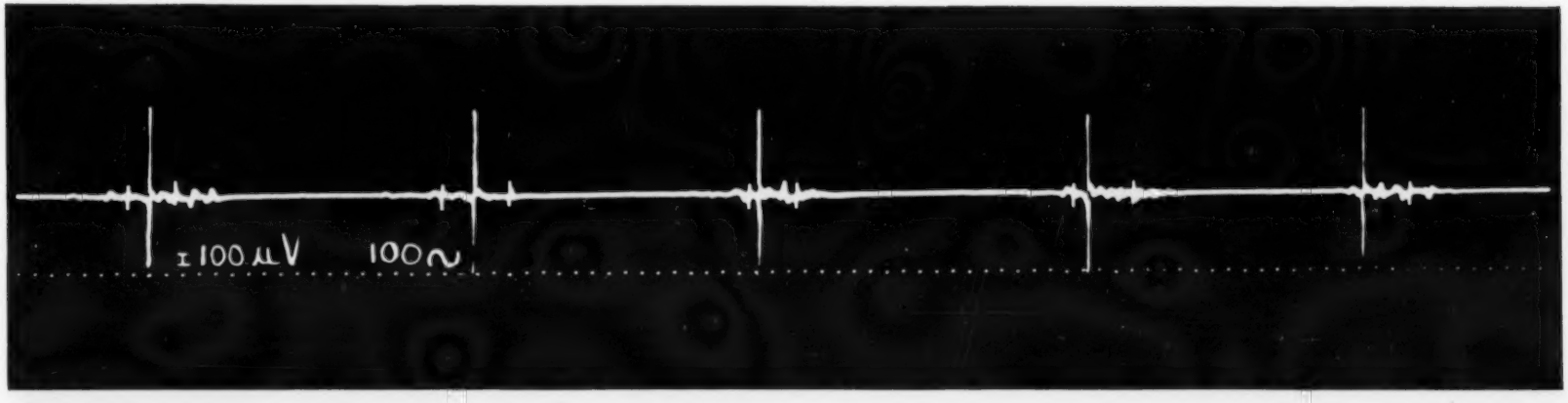

FIG. 3. (Mrs. O.B.Q.). One single large motor unit discharge recorded from the left extensor communis, representing part of the tremor before chemopallidectomy; the needle was in an unusually favorable position. Five units are shown. The interval between the first and second motor discharges was exactly the same as that between the third and fourth, and that between the second and third was exactly the same as that between the fourth and fifth. Time—100 cycles per second. Amplification was the same as in Figures 1 and 2.

FIG. 4. (Mrs. O.B.Q.). Voluntary contraction of left extensor communis. Record made four days after right chemopallidectomy. The degree of electrical activity of the muscle indicated no motor deficit. Time—100 cycles per second. Same amplification as in previous figures.

COMMENTS

This report represents an attempt to study tremor in Parkinson's disease by means of electromyography. One aim was to acquire some objective criteria that could be used when surgery is contemplated; the other was to collect more data on the problem of tremor and to try to understand its mechanism. The rhythmic activity of the different muscles can be recorded and analyzed, but tremor can vary in intensity in the same patient, depending upon multiple factors not directly related to any form of therapy. It is therefore difficult to measure this symptom, because it is a variable one. The interpretation of the findings is a complex undertaking if a thorough analysis be contemplated. Problems arise in the study of the activity of the different motor units that enter into play in a given motion. Even in the case of a slight willed motion of a normal muscle, the estimation of the number of motor units involved and their frequency of firing is not a simple matter. In the case of tremor, the frequent contractions (even when the needle is in good position) can result in minimal or even in microscopic displacement of the needle. This can create an additional technical difficulty in a more detailed study, such as that of single motor unit discharges.

In Figure 3 rhythmic discharges of single motor units were recorded. The rhythm was the same as the rate of the tremor. This suggests that a delicate mechanism is involved in tremor.

There is no known explanation for the regular rhythmic alternating motions of the tremor. Under some patho-physiologic conditions, synchronous and rhythmic discharges from the anterior horn cells can be observed. The "tremorgenic" centers are not known. An extremely complex system is formed by the multiple synapses from the pyramidal and cortico-extrapyramidal tracts, the basal ganglia interconnections, the numerous relays via the brain stem, reticular formation, and the multiple converging fibers to the anterior horn cells at different spinal levels. Following surgical elimination of some of the extrapyramidal system, namely the globus pallidus, dramatic changes can take place. The tremulous disorder of motion can sometimes be arrested instantaneously. One could therefore postulate that when the pathologic condition in the extrapyramidal and basal-ganglion systems is a partial one, some of the affected centers can become partially decentralized and eventually react as denervated structures in the broad sense of the word. These cells can become oversensitive, then be stimulated by metabolic, humoral or nervous factors. Such a process could result in rhythmic organized discharges, rhythmicity being one of the characteristics of the nervous system.

There are conflicting data in the literature concerning the problem of rigidity. It is evident that rigidity in parkinsonism is completely different from the rigidity of the decerebrate state, and represents a different clinical entity. More studies are being carried out and will be reported later.

SUMMARY

The tremor of Parkinson's disease has been studied by electromyography, both before and after chemopallidectomy. This presentation is therefore not an

evaluation of the total results of chemopallidectomy, but rather of its effect upon one important symptom of the disease.

Electromyograms of the tremor were obtained in over 30 cases. Rhythmic motions of muscles and antagonists were recorded.

Ten patients were studied before, and as late as a year after chemopallidectomy. The findings indicated beneficial results. Further follow-up is necessary, however.

One case has been reported in detail. A recording made four weeks after chemopallidectomy showed the complete disappearance of tremor. The patient had no motor deficit or any other complication as a result of the operation.

The mechanism and the origin of the rhythmic motions is not clear and has been discussed. At times during this study a recording was made of the activity of a single motor unit. The rate of discharge was the same as that recorded for tremor. This finding may indicate that individual anterior horn cells can be activated by the extrapyramidal system and discharge impulses at a rate similar to that of the tremor.

EARLY ELECTROENCEPHALOGRAPHIC OBSERVATIONS FOLLOWING CHEMOPALLIDECTOMY

GONZALO BRAVO, M.D. AND IRVING S. COOPER, M.D.

During our first electroencephalographic observations of parkinsonian patients who had been subjected to pallidal lesions for alleviation of tremor and rigidity (choroidal artery ligation; transtemporal or transfrontal chemopallidectomy), we observed that in some cases, besides the local transitory changes at the point of insertion of the needle, there were certain modifications in the electrical activity of the whole hemisphere of the brain. The actual significance of these changes remained questionable. This first group of patients was not homogeneous, as they had been subjected to different procedures. There was also variation in other factors, *e.g.*, in the length of time between the operation and the electroencephalographic recording, and in the electroencephalographic technique.

A routine standardized electroencephalographic study was planned in order to investigate: a) whether or not transcortical implantation of a chemopallidectomy catheter would be followed by paroxysmal rhythms initiated at the point of the cortical lesion, even if this lesion were minimal; b) possible changes in the electrical activity of the cortex as a result of the destruction of the globus pallidus; and c) the correlations, if any, between the preoperative and postoperative electrical activity of the brain. For measuring electrical activity we used the scalp electroencephalogram. The clinical results of the operation were measured by the immediate neurologic response.

METHOD

One hundred and sixty recordings were made in 85 patients, but 19 were eliminated from this series because either they were not operated upon, or the preoperative or the postoperative recording could not be obtained or was unsatisfactory. This left a group of 66 patients in which preoperative and postoperative recordings were available and adequate for comparison. Six patients of this group had been subjected to bilateral operations and they were also excluded from the present study because no reliable conclusions could be drawn from such a small number of cases.

The remaining 60 patients constitute a unit with the following common characteristics:

1. The diagnosis in all of them was parkinsonism, whether postencephalitic, arteriosclerotic or idiopathic. The causal factor was difficult to ascertain in most cases but no patients had clear signs of arteriosclerosis or marked encephalitic stigmata.

2. All the group had been subjected to the same standard surgical procedure — unilateral chemopallidectomy through the convexity (transfrontal) approach, the amount of alcohol injected varying between 0.25 and 1.25 cc.

3. The electroencephalographic examination was performed by the same tech-

nician using a bipolar technique with 18–20 standard electrode placements, and routine derivations. A period of hyperventilation was obtained in those patients who were able to cooperate adequately, but no other type of activation was attempted.

4. The records were numbered and selected at random for reading. By using this "blind procedure" the reader could not know if the record under study pertained to a preoperative or postoperative case or if it was a repeated record. This technique was devised so as to avoid as much as possible the interference of subjective factors during reading. In every case however the reader ended his report by stating whether, in his opinion, the record was a preoperative or a postoperative one. If considered to be postoperative, he proceeded to state on which side he thought the operation had been performed. When the records were reviewed it was found that only 3 wrong classifications had been made; thus the accuracy was 95 per cent.

5. Preoperative recordings were made from one to three days preceding surgery; postoperative recordings were obtained from three to eleven days following removal of the catheter from the brain. The mean interval between removal of the catheter and the postoperative electroencephalogram was five days. In 4 cases records were repeated within a week, and in 3 cases second postoperative recordings were obtained twenty-two, twenty-eight and thirty-seven days, respectively, following the first one.

6. Medication was a variable factor, inevitably. Different patients received different medications, and sometimes the same patient received different medications or different doses of the same medication—before and after the operation. The electroencephalographic findings were the same in a) the general group and a group of 4 patients in whom medication was discontinued for at least forty-eight hours prior to the preoperative and postoperative recordings; and b) the general group and a group of 5 patients who received the same medication before and after the operation. However, the possible influence of the drugs upon the electroencephalogram cannot be disregarded.

No attempt was made in the present series to classify the electroencephalograms with respect to normality, but only to compare the preoperative and postoperative records of each patient regarding three main characteristics—speed, voltage and alpha index. In order to correlate the preoperative findings with the postoperative findings, the patients were rated as described in the reports of Diller *et al.* (1), and by the same observers. Postoperative ratings based on criteria such as "better," "unchanged" or "worse" were not considered useful from our point of view.

The patients were divided into four groups as follows:

Group 1—Patients in whom there were no signs of neurologic deficit. They remained alert and fully cooperative immediately after the operation and the reinjections, and were usually up and around twenty-four to forty-eight hours after the insertion of the catheter into the globus. They constituted 15 per cent of the total group under study.

Group 2—Patients in whom there were mild and transitory signs of facial weakness, extensor plantar response, drowsiness, or slight mental confusion. This group constituted 51 per cent of the total.

Group 3—Patients who had one or more of the following symptoms: drowsiness or mental confusion lasting for at least eight days after the last alcohol injection; weakness of one or both extremities, even if mild and transitory; marked facial weakness; or an extensor plantar response at the time of the electroencephalographic examination. This group constituted 18.4 per cent of the total. Except for a few cases of persistent Babinski response, all the other signs of neurologic impairment had cleared up in these patients within one to two months after operation.

Group 4—Patients who had some kind of permanent or long-lasting deficit, regardless of its severity. These deficits varied from slight loss of memory and speech difficulty (2 cases), to rather marked drowsiness and confusion (4 cases), to contralateral hemiplegia with or without aphasia due to postoperative hemorrhage (3 cases). This group constituted 15 per cent of the total.

The foregoing figures differ somewhat from those obtained when the total number of cases undergoing operation is taken into account, because the 60 patients under consideration were a spontaneously selected group. Some patients having good surgical results were too eager to leave the hospital and thus were lost for postoperative electroencephalographic study. On the other hand, patients having unsatisfactory surgical results or a stormy postoperative course usually remained in the hospital long enough for postoperative studies.

RESULTS

Some of the characteristics of the preoperative recordings have already been mentioned in a previous paper dealing with the evaluation of parkinsonian patients as candidates for surgery (2). The series of patients considered there includes the 60 in this study. A similar correlation between the severity of the parkinsonian manifestations and the electroencephalographic findings can be applied to the present group.

The main findings were: low voltage, intermediate-fast to fast rhythm, and fair to poor alpha activity. These became more evident when the preoperative and postoperative recordings were compared. All but 3 records were identified correctly as to preoperative or postoperative time-period, and as to the side of the operation in the postoperative group. Two slow, asymmetrical recordings were classified as postoperative, and 1 of the postoperative records was classified as preoperative. In the latter case, a careful check of the preoperative and postoperative records failed to show any difference between them.

The chief findings in the postoperative electroencephalogram were: an over-all decrease in the speed of the rhythms, with a still more pronounced slowing over the hemisphere operated on; an over-all increase in voltage in 60 of the recordings; bursts of delta or theta waves, sometimes appearing bilaterally over the anterior half of the head, sometimes limited to the temporo-anterior parietal

leads on the side which had been operated on; a marked increase in the size and frequency of the sleep patterns; a decrease in the mean frequency of the alpha rhythms (the only change in two recordings—switching of the alpha rhythm from a preoperative frequency of 11 p/s to a postoperative frequency of 8 p/s); a decrease in the total alpha index (observable in 35 per cent of the postoperative records); and disappearance of the muscle potential artefacts on the temporo-frontal leads contralateral to the side of the operation.

The most reliable criteria for the identification of postoperative records were: over-all decreased frequency (99.6 per cent of the cases); medium-voltage theta or delta waves over the temporo-parietal area on the side which had been operated on (91.3 per cent of the cases); or a diffuse increase in voltage, more marked on the side of operation (60 per cent of the cases).

Some postoperative records could hardly be classified as abnormal, as there was only mild asymmetry between the two hemispheres. However, even in these cases, the difference between the preoperative and postoperative recordings was evident.

The correlation between the abnormality of the postoperative record and the neurologic signs and symptoms of the patient, as measured by the foregoing four groups of surgical responses, was rather consistent. There was only 1 abnormal postoperative record among those of the patients in Group 1, although they had abnormal records preoperatively. All of the records of patients in Group 4 were grossly abnormal. However, the term abnormal is used here only to signify a marked deviation from the preoperative type of record. No convulsive patterns or paroxysmal activity was observed in any of the recordings. In only the 3 patients suffering a postoperative hemiplegia did the electroencephalogram show disorganized, high-voltage, slow rhythms with no trace of normal activity over the affected hemisphere.

Although evaluation of drowsiness varies from one observer to another, and drowsiness fluctuates in the same patient from one moment to another during any 24-hour period, it seemed that the aforementioned postoperative electroencephalographic changes bore a closer relation to the mental alertness and awareness of the patient than to any other neurologic signs.

The duration of the electroencephalographic changes following surgery is still an open question. We plan to follow these patients closely in order to ascertain if the changes are of a permanent nature, or if they bear any relationship to a possible recurrence of symptoms or to the progression of the disease in the side of the body not affected by the operation. The 3 patients thus far examined from four to five weeks following surgery belonged to Group 4 and manifested persistent electroencephalographic changes in spite of definite clinical improvement. In 5 patients not included in this series (because they were subjected to a chemopallidectomy through the subtemporal approach) the electroencephalogram still showed higher slower rhythms over the surgically treated hemisphere eight to twelve months after operation. Unfortunately, in none of these 5 cases was the immediate postoperative recording available.

CONCLUSIONS

The electroencephalographic patterns before and after unilateral transfrontal chemopallidectomy have been studied in 60 parkinsonian patients. Although further evidence must be accumulated during a long-term follow-up period, the findings in this group indicate that unilateral chemopallidectomy exerts an effect upon the cortical rhythms of the cerebral hemisphere concerned, as recorded in the scalp electroencephalogram. The postoperative changes consist mainly of decreased frequency; an ipsilateral or, at times, bilateral increased voltage; occurrence of medium-voltage theta and delta waves in the temporo-parietal leads (bilaterally or limited to the surgically treated side); and a bilateral increase in the number of sleep patterns.

REFERENCES

1. Diller, L.; Riklan, M., and Laszewski, Z.: Effects of anterior choroidal artery occlusion and of chemopallidectomy on the tremor and rigidity of Parkinson's disease: an independent appraisal, *J. Am. Geriatrics Soc.* **4:** 1246–1248 (Dec.) 1956.
2. Fairman, D., and Cooper, I. S.: Criteria in the selection of parkinsonian patients for chemopallidectomy, *J. Am. Geriatrics Soc.* **4:** 1214–1218 (Dec.) 1956.

ROLE OF THE DEPARTMENT OF REHABILITATION IN PREOPERATIVE EVALUATION OF PARKINSONIAN PATIENTS

ZOFIA LASZEWSKI, M.D.

In selecting patients for chemopallidectomy, certain routines are observed by different departments, including the Department of Physical Medicine and Rehabilitation.

METHODS OF TESTING

Two separate charts for tabulation of findings have been devised, by means of which twofold evaluation is carried out. The first provides information about clinical symptoms; the second provides information about the level of functioning or the degree of handicap in functional activities.

Chart 1. This chart is divided into three main parts:

A. *Medical.* In addition to details about the patient's social, occupational and educational background, this record provides information regarding diagnosis, etiology, onset, duration and progression of symptoms and the areas mostly involved, neurologic findings, special assessment of rigidity and tremor in relation to different parts of the body, and clinical findings such as pain, fatiguability, dysphagia, bradykinesia and dystonic deformity. In addition, it contains a brief appraisal of psychologic and emotional functioning and motivation of the patient.

B. *Detailed physio-therapeutic tests.* These consist of muscle testing, functional or active-range-of-motion testing, detailed gait, posture and balance evaluation, grading of spontaneity of movements, noting the presence of contractures, and special estimation of respiratory faculties.

C. *Speech evaluation.* This includes speech attitudes, conversational speech, general voice and speech characteristics, and language skills. A separate set of questions is provided for the use of professional personnel for quick appraisal of speech disorders.

Chart 2. This is a routine chart for testing activities of daily living and bears estimates of the normal time required for performance of activities. Since time is an important factor in the general functioning of each parkinsonian patient, such an estimation proves helpful when tests are conducted to determine the degree of slowing down of the patient, either preoperatively or postoperatively.

EVALUATION

1. *General factors*

In each case of Parkinson's disease there are different areas of involvement which determine the variability of physical and functional handicap. In addition, there are general contributing factors such as age; duration and etiology of the disease; severity of symptoms and whether disseminated, bilateral, unilateral or midline; predominance of rigidity or tremor; and pre-existing psychologic

factors. All these materially influence the degree of handicap as well as the ultimate result of neurosurgery.

Furthermore, in evaluating the incapacitation caused by the progression of Parkinson's disease, the expected level of functioning should be predetermined and ultimate goals anticipated. For instance, in certain patients, usually more severely affected, it may be sufficient if independence in self-care is regained, thus dispensing with nursing care. On the other hand, some patients may be expected to return to the task of earning a living; therefore the aim is not only self-sufficiency but also the ability for productive functioning.

Similarly, intellectual and vocal functioning represent important points in the over-all appraisal. Whereas both may be of secondary importance in a case of a laborer, in a college professor or a salesman they constitute a functional prerequisite.

2. *Specific factors*

A. *Rigidity.* The quality of the patient's handicap is determined by the degree and distribution of the rigidity. It may be mild, moderate or severe; it may be local, peripheral, midline, bilateral or generalized. The following are a few examples. In bilateral rigidity of the shoulder girdles, the patient may find it hard to raise his arms above his head. This will cause difficulty in putting his clothes over his head. In midline rigidity, bed activities will be impaired, especially turning, and assuming the erect position. Thus reaching the lower extremities becomes impossible. In rigidity limited to the lower extremities, walking presents a major problem.

In extreme rigidity of the hands, dystonic deformity develops in which there is flexion of the metacarpophalangeal joints and hyperextension of the proximal interphalangeal joints with simultaneous shortening of the tendons of the long extensors and over-stretching of flexor tendons. This results in the patient being unable to flex the fingers. At times, however, generalized extreme flexion deformity develops, and tightness of the flexors and over-stretching of the extensors ensues. Such hands become completely useless. Similarly, there may be an increased tendency to pronation of the forearm, with simultaneous limitation of supination. In generalized advanced rigidity, the patient becomes totally incapacitated and requires full nursing care. Such patients often may lose their tremor completely at the expense of increasing rigidity.

Since agonist-antagonist rhythm suffers in the presence of rigidity, it usually involves anti-gravity muscles more than their antagonists. This is well demonstrated in lead-pipe rigidity, a condition in which the greatest resistance elicited will be upon testing the biceps and hamstrings rather than the triceps and quadriceps. Only in severe involvement may such rigidity be equal in both groups. Rigidity is less prone to develop in weight-bearing muscles than in those that do not bear weight; therefore shoulder girdles and the upper dorsal regions are more extensively involved than the lower extremities.

Care should be taken in differentiating the type of rigidity due to extrapyramidal involvement, and spasticity due to disease of the pyramidal tracts.

The following simple clinical tests are being used for diagnostic purposes: 1. The rigidity of parkinsonism is elicited on movement slower than that used for testing of spasticity, according to certain authorities. With this test is obtained a combined movement of step-like segmentations (as in the case of cogwheelism), or a plastic but smooth resistive motion as in the case of lead-pipe rigidity. 2. According to the French school, parkinsonian rigidity can be augmented by simultaneous movement of the contralateral extremity, a phenomenon which does not occur in spastic lesions.

B. *Tremor*. Tremor, especially at the beginning, may be a handicap from a social rather than a functional standpoint, but with the progression of the disease it becomes equally as handicapping as rigidity, particularly if it occurs during motion (intention tremor). Fortunately, in Parkinson's disease, intention tremor is not as frequent as resting tremor. Tremor which occurs at extremes of motion may be for all practical purposes classified as resting tremor, because at these points the movement comes to its completion and the rate of acceleration falls to zero. Such tremor usually becomes gross and almost ataxic in character. It is the most handicapping of all types and is exemplified in inability of the patient to feed himself. Generally, when tremor is present, the use of hands for fine activities such as writing and buttoning is severely impaired.

Tremor may also be classified as mild, moderate or severe. Its quality may be rhythmic, fine or gross, merging to almost athetoid movements; in such cases characteristically it is usually limited to one upper extremity.

C. *Balance, gait and posture*. Both tremor and rigidity influence materially the balancing faculty. It becomes increasingly difficult for the patient to control his equilibrium with the progression of the disease, both in the dynamic phase of walking and while at a standstill. Balance can be impaired, not only in the erect position, but in the sitting position. This is particularly conspicuous following surgical treatment.

Certain characteristic gait patterns develop which may be summarized as follows: Dragging of the foot may herald the onset of difficulty. Steps may become short and shuffling while the base narrows. At times, there is actual scissoring and the patient may trip over his own feet. The gait becomes faster and running in type, and the patient has little control over it. Such gait results in propulsion, although retropulsion or lateral-pulsion may also exist. Ability of progression depends upon constant losing and regaining of balance and is achieved by an alternate shortening of the lower extremities in which the whole body participates in rhythmic fashion by elevation, depression and rotation of the pelvis and the trunk, depression and elevation of the shoulder girdles, and simultaneous reciprocal swinging of the arms. Thus it is obvious why rigid patients lose the sequence of these phases of natural elastic gait.

The normal gait can be divided into two phases, the phase of propulsion and the phase of restraint. The former is usually shorter than the latter. While these two phases constantly alternate, a period of double support occurs. The faster the gait, the shorter it becomes, until it disappears completely in running. For every speed of gait there is a limit beyond which the propelling action can no

longer be neutralized by the restraining phase. For normal functioning, progression has to have uniform velocity.

The phase of restraint disappears in cases of rigidity. Therefore the patient tries to increase the period of double support, which results in a short, shuffling gait as if he were afraid of raising his foot from the floor. In addition, the center of gravity remains high due to short steps in which inclination of the lower extremity becomes greater than when long steps are taken. With postural complications such as dorsal kyphosis and marked forward protrusion of the head and neck, the center of gravity is thrust forward. All these factors contribute to faulty ambulation and disturbance of balance.

The most common postural problems are those of generalized semi-flexion. This condition results in moderate tightness of the structures concerned with flexion, such as neck flexors, pectorals, elbow flexors, pronators of the forearm, hip flexors, knee flexors and plantar flexors.

Extensor mechanisms seem to be unable to maintain adequate balance and prevent postural deviation in Parkinson's disease. Therefore, kyphosis and a simian appearance are characteristic postural features. Rigidity of the shoulder girdles increases the kyphosis of the dorsal spine and renders excursion of the scapulae impossible, especially in the effort of provoking retraction.

D. *Bradykinesia.* General slowing down may be one of the initial symptoms of Parkinson's disease. It increases with the progression of the illness, and may result in bradykinesia or even frank akinesia. Lack of spontaneity of movement may be an associated symptom.

E. *Motor power.* Muscle testing usually shows no material impairment of motor power. However, in the case of severe rigidity, testing may be of little value because of the inability of the patient to carry out instructions. It is nevertheless performed routinely and the results serve as a base line for postoperative comparison.

F. *Range of motion.* Testing usually shows this factor to be unimpaired. Passively all joints can be brought up to the full range of motion unless severe dystonic deformity is present with permanent changes in the joints. Tests for functional active range of motion, in which the patient is asked to perform individual movements to the limits of his own ability, furnish a much better estimation of the degree of postoperative relief than do routine determinations of the passive range of motion measured in degrees. The following example illustrates the value of this test. A patient who prior to neurosurgery was not able to shrug his right shoulder due to extreme rigidity of his right upper trapezius, regained full movement through the active contraction of the muscle following operation.

G. *Respiratory system.* In most cases there is a marked decrease in vital capacity. This is partly due to the involvement of the intercostal, facial, pharyngeal and laryngeal muscles. Chest measurements show very little difference in chest excursion during either inspiration or expiration when trunk muscles are involved. Recently we have started routine breath-holding tests, but no generalizations can be made as yet. It is worth while to synchronize physical therapy with speech therapy, and these departments cooperate closely in developing anti-

gravity and respiratory muscles along with the small muscles concerned with speech, namely, those of the tongue, lips, cheek, palate, pharynx and larynx.

H. *Psychologic status.* Psychologic tests show that in parkinsonism there are the same general problems as in any chronic illness. However, in parkinsonian patients with constant tremor, fear and worries develop which merge into paranoic traits of suspiciousness. As a rule, there is no behavior psychosis, but it may be demonstrated as an underlying factor in 10 to 15 per cent of cases. About the same number have a so-called organic mental syndrome with memory impairment and confusion of thinking and orientation. A great many parkinsonian patients are neurotic; the percentage approximates that observed in the normal population. In those who are more severely disturbed and have organic changes, certain patterns are found. There is the passive, dependent, quiet, introverted person, with fantasies of his own, more intellectual in character; or there is the egocentric, childish person. The latter type is particularly related to the passive, dependent type with regression in maturity. As a rule, these patients never show aggression or hostility; actual aggression, if shown, may be only a symptom of frustration. Parkinsonian patients do not seem to manifest any conspicuous psychologic disturbances or personality changes, and from that standpoint most of them present good neurosurgical risks with adequate rehabilitation potential.

I. *Speech.* A significant number of patients suffering from Parkinson's syndrome have impairment of speech, the degree of which may vary from mild to severe. Voice and speech characteristics are more often involved than communication and speech attitudes. In mild cases, usually volume becomes impaired first. In severe cases, fading out of the voice may become complete aphonia. The quality of the voice may change and become breathy. The patient may be unable to initiate speech, may exhibit delay in initiation, or may be incapable of supporting and sustaining the tone properly. The rate often becomes arrhythmic and rapid. Phrasing may be inappropriate to the ideas expressed and there may be sudden bursts of speech. Articulation is commonly affected; it may be slack and dysarthric. Substitutions and omissions of words are frequent. Tremor, especially if severe, may interfere with reading ability. Rigidity of the muscles of the lips, palate, tongue, pharynx, and larynx, and inability to use the anti-gravity muscles, contribute much more to the speech disorders than does the impairment in vital capacity. Functioning of vocal cords is worth studying for better evaluation of speech disorders.

SUMMARY

An outline has been presented of the methods used in evaluation of parkinsonian disability in the Department of Physical Medicine and Rehabilitation.

The most common areas of affliction have been discussed, and the contribution of each member of the rehabilitation team in final classification of patient's disability has been stressed.

It is important to set up feasible goals in each case prior to operation, with special consideration of the patient's social, intellectual, and occupational background.

SPEECH PROBLEMS IN PARKINSONIAN PATIENTS UNDERGOING ANTERIOR CHOROIDAL ARTERY OCCLUSION OR CHEMOPALLIDECTOMY

JOYCE FELSTEIN BUCK, M.A. AND IRVING S. COOPER, M.D.

This paper is a preliminary report of a pilot study of the speech problems of parkinsonian patients prior to surgery, and the degree of change effected by neurosurgical intervention.

PROCEDURE

Sixty-five patients were observed, ranging in age from 31 to 74 years. Fifty-eight per cent were under 50 years of age, most of them in the age group 40–50 years. Among the patients over 55, the symptoms of parkinsonism had generally been present for five or six years. Among the patients in their forties, the symptoms of parkinsonism had appeared early in life, the duration of the disease having been approximately ten to twenty years.

Preoperative and postoperative evaluations were made in 46 patients. The remaining 19 did not receive this complete appraisal because: 1) their poor condition prohibited surgery, 2) there was insufficient testing time prior to operation and prior to the discharge from the hospital, and 3) there was poor cooperation.

By means of interviews, tape recordings and standard speech examinations, the various areas pertaining to speech were observed and evaluated quantitatively or qualitatively, as follows:

Oral musculature

Examination included placement of the tongue, lips and jaws in positions of elevation, depression, lateralization, protrusion and clósure. These isolated volitional activities were rated on a 3-point scale based on normal, weak and uninitiated performances. A quantitative measure of the *lingual diadokokinetic rate* was obtained by tape recordings in order to determine the number of successive contacts made by the tongue tip elevating to the palatal rugae in a 5-second period during the rapid production of such sounds as "da, da," and "ta, ta." This test involves an ability to sustain volitional and spontaneous movement—an ability which is often impaired in the motor behavior of parkinsonian patients.

Integrated activity of the articulators

Observation of this activity in conversation, oral reading and imitation furnishes a gross picture of the *functional motility* of the articulators as they work together in the production of sounds. Repetition by the patient of prepared sentences given orally, and oral reading of passages containing labial and alveolar sounds can reveal the extent of articulator contact or of completion of movement of the lips and tongue, *e.g.*, "James went home," "Stella slipped on the street."

A rough 4-point rating scale was used to determine functional motility of the articulators: 1) normal, intelligible speech, 2) slightly slurred articulation, 3) moderately slurred articulation, and 4) little or no movement of the articulators.

Phonation

Phonation was observed most closely in the area of vocal intensity but the aspects of quality, pitch and intonation were subjectively considered. A 4-point rating scale to measure the degree of vocal intensity was used as follows:

Scale 1. *Inaudible* phonation, *i.e.*, aphonia, either complete or intermittent.
Scale 2. *Barely audible* phonation, *i.e.*, weak vocal intensity, heard only with great effort by the listener.
Scale 3. *Weak audible* phonation, characterized by a noticeable decline in the intensity of the voice.
Scale 4. *Normal* or *adequate* audibility or vocal intensity, marked by ease of communication.

Timing the ability to sustain a tone was the most objective measurement employed in the vocal analysis. Quality and intonation could only be described crudely as hoarse, raspy, guttural, clear; intonation as flat (monotonous) or normal.

Language ability

In order to determine the presence of symbolic disturbances, preoperatively and postoperatively, qualitative observations were made of the patient's ability to discuss his condition coherently in a standard interview, ability to formulate sentences volitionally using stimulus words, and his ability to read aloud.

Speech involvement

This factor was measured by the ratings of 3 judges, 2 psychologists and a speech pathologist (J.F.B.) In employing a 5-point scale to measure the degree of speech involvement an average agreement of 90 per cent was attained by the three judges, who made their ratings separately according to the following scale:

Scale 1. *Severely disturbed* speech, *i.e.*, completely or nearly unintelligible. Included are intermittent aphonia or periodic loss of voice.
Scale 2. *Moderately severe* disturbance of speech fulfills the following criteria: It is independent of fatigue and stress; the speech can be only partially understood with considerable difficulty by the auditor and is produced with considerable effort by the speaker. Patients requiring two or three repetitions would fit into this category.
Scale 3. *Moderately* involved speech is intelligible and audible most of the time, but a noticeable decline in these areas is evident. Periods of fatigue, stress or anxiety affect speech adversely.
Scale 4. *Mildly* disturbed speech is easily understood. There is a barely perceptible decline in articulation, vocal intensity, quality and use of language.
Scale 5. *Normal speech* is easily understood and is within the normal range with respect to articulation, vocal intensity, quality or language usage. Standards are those expected for normal everyday communication, judged by what each person requires for himself, depending upon his needs.

Physical involvement

This measurement was a combined one, involving both impairment of movement and the ability to perform the activities of daily living such as self-feeding, dressing and ambulation. It was obtained by the combined ratings of the 3 judges. A 3-point scale was employed, based on: 1) the ability of the patient to care for himself independently, 2) need of assistance, and 3) complete dependence or incapacitation.

Structural symptoms

In parkinsonian patients these are rigidity, tremor or a combination of the two. Clinically, the physical disability of patients in this series was classified according to three types: 1) rigidity—predominant in any or all extremities; 2) tremor—outstanding in one or more limbs; and 3) rigidity-tremor—both symptoms equally prominent.

RESULTS

Of the 65 patients examined, 24 (37 per cent) had normal speech or mild involvement, 22 (34 per cent) had a moderate degree of speech involvement, and 19 (29 per cent) had severely impaired speech.

An analysis of the relationship between certain factors related to the speech of these parkinsonian patients showed:

Duration of Parkinson's disease as related to speech. Ten of the 15 patients who suffered from parkinsonism for the longest period of time (sixteen to thirty years) had severe speech involvement; 3 of the 15 had mild speech disorders. Among 27 patients in whom the disease had lasted from one to eight years, speech disturbances were mild in 14 and severe in 3. Statistically, a 2 per cent level of confidence confirmed a clinical observation that the longer periods of physical illness affect the sensitive speech mechanism, both because of the organic involvement and the psychologic influence of long-term illness.

Degree of physical involvement as related to speech. The general physical involvement in parkinsonian patients is significantly correlated with the degree of speech involvement (3 per cent level of confidence). Among 23 patients who were totally incapacitated speech disturbances were severe in 10 and mild in 3. Among 21 physically independent patients, speech disturbances were mild in 14 and severe in 2.

Structural symptoms. Statistically, a confidence level of better than 1 per cent demonstrated that patients with a predominantly rigid physical condition usually have severe speech involvement. Patients with a predominant tremor tend to have mild speech involvement. In our series, among the 19 patients with predominant rigidity, speech disturbances were severe in 10 and mild in 1. Among 25 patients in whom tremor was predominant, speech disturbances were severe in 1 and mild in 17.

Lingual diadokokinetic rate as related to speech. Although we do not dispute the value of the lingual diadokokinetic rate, our findings show no significant relationship between the lingual rate of movement and the degree of speech

involvement. As might be expected, however, there is a trend toward an association between a poor diadokokinetic rate and severe speech involvement. Among 14 patients with severe speech disturbances, 7 had fewer tongue movements per second.

Oral musculature as related to physical status. Among 57 parkinsonian patients, the oral musculature was normal or only mildly involved in 41, that is, they retained the ability to produce isolated voluntary movements of the tongue, lips, and jaw. In only 5 patients were the articulators obviously paretic and unable to perform lateral, alveolar and labial movements. In considering the relationship between the condition of the oral musculature and physical status, it was determined whether the limited movement of the extremities or the slowness thereof was accompanied by a similar condition in the oral musculature. The data on 57 patients revealed a lack of correlation. A severely disabled patient may have a normal oral musculature which performs well for isolated voluntary movements. However, there was a tendency for physically mild cases of the disease to be associated with normal oral musculature, whereas physically severe cases were associated with poor oral musculature.

Oral musculature as related to speech. A significant statistical correlation at the 5 per cent level of confidence exists between the condition of the oral musculature and the degree of speech involvement. In 16 patients the oral musculature was severely affected; in 8 of these, speech disturbance was severe and in 2 it was mild. Among 25 patients with mildly involved or normal oral musculature, speech was only mildly disturbed or normal in 15; in 3 it was severely disturbed. On the extremes of the scale, it appears that patients with normal oral musculature have mild speech involvement, whereas patients with weak or paretic oral musculature have the most severe speech disturbances.

Oral musculature as related to lingual diadokokinesis. Bradykinesia, characteristic of the general parkinsonian picture, cannot be demonstrated by the voluntary isolated activities of the oral musculature. Measurement of the lingual diadokokinetic rate in 48 patients revealed that three fourths of them had slow rates of 4 to 5 lingual alveolar movements per second as compared with the average norm of 7 movements per second. However, there was no correlation between the condition of the oral musculature and the lingual diadokokinetic rate. Patients with normal oral musculature had both high and low rates of lingual movement.

Oral musculature as related to functional motility. In the complex process of articulation, the labial and the alveolar sounds appear to suffer most. Articulation involves the combined activity of the articulators whereby, normally, the tongue tip makes complete and strong contact with the hard palate for the production of alveolar sounds, and the lips meet. The defect in this process was clinically judged to be more marked than the defect in isolated volitional movements of the articulators.

More than half the patients had slight and moderate slurring in speech or incomplete contact of the articulators. The data indicate that the rate of lingual movement was not related to functional motility. However, there was a trend

toward association of normal functional motility with high diadokokinetic rates. Subjective rating scales and the small number of patients did not contribute to accurate measurement.

Phonation was affected in the majority of patients, particularly in the area of vocal intensity. In over half of all patients there was a deficiency in volume, so that the voice ranged from weakly audible to barely audible. Nine patients were aphonic or intermittently aphonic, and in 8 of these the condition was accompanied by rigidity of one or all extremities.

Problems in the area of phonation were found to predominate over problems of articulation in 42 cases. In 14 cases, articulation and phonation were equally affected. Articulation was the most impaired component in only 4 cases. Characteristics of the voice in most of the patients were raspiness, hoarseness, thinness, and lack of resonance, color and timbre. A tremulous quality was often noted in patients with severe tremor of the extremities.

Although most patients were able to sustain a tone for from ten to twenty seconds, shallow, irregular respiratory patterns appeared to be part of the parkinsonian speech syndrome.

EFFECTS OF NEUROSURGERY UPON SPEECH

The postoperative speech picture varied. There was complete loss of speech for forty-eight hours following operation in a few cases, with a subsequent gradual ability to symbolize. In a few patients there was a return to sentence formulation accompanied by frequent to occasional anomia and dysarthria. Other symptoms were agraphia and alexia, which gradually disappeared in most cases. In 2 cases of transitory dysphasia, the velum was involved to the extent that there was hyperrhinolalia. A peculiar phenomenon was observed in 1 patient—sentence formulation was fairly well preserved but the ability to sustain phonation or vocal cord activity was impaired, resulting in intermittent aphonia.

In half of the group of 46 patients evaluated both preoperatively and postoperatively, speech remained the same or was improved; in the other half there was a slight decline in speech efficiency following operation. The differences in these scores ranged from 0.5 to 2.0. These patients were evaluated within six to eight weeks after surgery. A more reliable postoperative appraisal can be made after the lapse of a year, when the immediate effects of operation (such as confusion or emotional distress) are no longer present.

More than half of a group of 49 patients thought their speech remained the same or had improved following operation; 18 believed their speech had become worse. Among these 18, temporary postoperative confusion and slowing down accounted for this decline in the efficiency of speech in many instances.

SUMMARY

A pilot study is presented of the speech problems in 65 parkinsonian patients, 46 of whom underwent either anterior choroidal artery occlusion or chemo-

pallidectomy. In these 46 cases, both preoperative and postoperative studies were made.

Isolated volitional movements of the articulators may be normal in most parkinsonian patients but the ability to integrate these isolated movements into an organized and patterned performance is defective.

The combined volitional and spontaneous aspects of any performance which requires the ability to initiate and to sustain speech are markedly affected. Characteristics due to the brain injury are inconsistencies of performance in part due to fatigue and stress.

Research into the area of respiration and its relation to phonation is sorely needed. Loss of automatic inspiratory activity may account for the gradual fading away of the voice so commonly observed in parkinsonian patients.

Although a small number of the parkinsonian patients in this series experienced significant improvement in speech following operation, neurosurgical intervention did not improve speech consistently. *Therefore, improvement in speech should not be a prime goal in selecting patients for surgical treatment of parkinsonism. Rather, patients should be selected on a basis of the degree of incapacitation due to rigidity and tremor.* They should be informed that whereas 70 per cent of patients obtain material alleviation of tremor and rigidity following operation on the globus pallidus, less than 20 per cent experience a similar degree of improvement in speech.

PSYCHOSOCIAL FACTORS IN PARKINSON'S DISEASE

LEONARD DILLER, PH.D. AND MANUEL RIKLAN, PH.D.

From ancient times, common-sense lore has alleged that a "sound mind" and a "sound body" go hand in hand. The obvious implications of this remark—a "crooked body" and a "crooked mind"—has focused interest on the psychologic aspects of chronic disease.

It is well known that the effects of Parkinson's disease are both extensive and varied, involving not only the patient's neuromuscular apparatus but also his psychologic functioning (1, 2). Indeed, a disease which manifests itself by an increasing inability to exercise voluntary control over the body, the cause of which has long been clouded in mystery and the symptomatology of which cannot be hidden from the public gaze, would of necessity be associated with psychologic phenomena. Consequently, there is a need for factual material concerning the social and psychologic components of the disease.

During the past three years we have had occasion to examine a fairly large sample of parkinsonian patients who were referred for neurosurgery (3). They were presented as surgical candidates chiefly for the relief of tremor and rigidity—primary symptoms in Parkinson's disease. They came from many parts of the country and usually were referred by their local physicians and neurologists. They were evaluated psychologically on a routine basis within one week before undergoing the neurosurgical operation

I. PSYCHOSOCIAL BACKGROUND

Detailed personal histories were obtained from 108 patients by means of interviews. In some instances, information also was obtained from relatives who accompanied the patient. The data gathered for presentation in this section include the following: sex, age, marital status, length of illness, educational and vocational background, and leisure-time activities.

A. *Sex*

The group consisted of 66 men and 42 women.

B. *Age*

Table 1 presents data on the distribution according to age. It may be seen that the patients ranged in age from 34 to 75 years, with a mean age of 49.5. The median age was 49 years, with a fourth of the patients over 56 years and a fourth under 42 years of age.

C. *Marital status*

Of the total group, 82 (79 per cent) said they had been married at one time, and 26 (21 per cent) said they had never been wed.

A detailed analysis concerning marital adjustment was culled from the histories of 59 patients. Table 2 presents a summary of these data, from which it

TABLE 1. *Distribution of 108 Parkinsonian Patients According to Age*

Age (yrs.)	34–40	41–50	51–60	61–75
No. of patients	20	37	40	11

TABLE 2. *Marital Status of 36 Male and 23 Female Parkinsonian Patients*

	Male		Female		Total No.
	No.	Per cent	No.	Per cent	
Happy marriage	4	11	8	35	12
Adequate marriage	7	19	8	35	15
Married twice	3	9	2	9	5
Unhappy marriage	9	25	1	4	10
Unmarried	13	36	4	17	17
Total	*36*		*23*		*59*

may be seen that the marital patterns of the men differed somewhat from those of the women. Thus, 61 per cent of the men had never married or had been unhappily married, whereas only 21 per cent of the women reported this pattern. On the other hand, 70 per cent of the women claimed adequate or happy marriages, whereas only 30 per cent of the men claimed similar experiences. The effects of the disease on marital status appear to be pronounced, in that many of the males reported they never felt physically, psychologically and financially secure enough to support a wife because of parkinsonism. Many complained of shyness and isolation with regard to members of the opposite sex. Many of the unhappily married persons stated that the disease aggravated an already strained marital relationship.

D. *Duration*

Most of the patients had been ill for many years. In Table 3 data are presented on the number of years since the onset of symptoms in our series. Symptoms were first noted anywhere from one to thirty-six years prior to our examination. The mean length of illness was 10.9 years. When the 20 cases of longest duration were compared with the 20 of shortest duration, no significant relationship was found between the following variables: length of illness, age, and severity of incapacitation due to tremor and rigidity.

E. *Educational and vocational achievements*

Our group was composed of a diverse and slightly superior sample of people insofar as educational and vocational achievements were concerned. Educational data were available on 92 patients and vocational status on 90. Vocational status refers to the major type of work, as volunteered by the patient in the vocational history. The findings on vocational status were not substantially different from those reported for other chronic illnesses (4). Forty-one per cent of the group were classified as professional or skilled workers, *e.g.*, college pro-

TABLE 3. *Duration of Symptoms in 108 Parkinsonian Patients*

Duration (yrs.)	0–3	4–6	7–9	10–13	14–17	Over 18
No. of patients	10	26	19	17	19	17

fessor, lawyer, or musician. More patients were engaged in sedentary or white-collar occupations than in physically active pursuits (2). Only 6 per cent of the group was classified as unskilled. About a third of the males had been unemployed for at least a year prior to undergoing operation; a fourth were still employed at the time of admission.

With regard to educational background, 37 per cent had at least some college training. The group as a whole (mean age, 49.5 years) had an average of twelve years of formal schooling. This is superior to the educational training of a parallel age group reported in the 1950 census who completed an average of 8.8 years of schooling (5).

F. *Leisure-time activities*

Responses to questions concerning leisure-time activities were available on 46 patients. Most members of the group appear to enjoy sedentary leisure-time pursuits, including reading, movies, and television. Several patients reported having to give up more active interests such as sports and dancing.

Comment

In review, examination of 108 parkinsonian patients whose average age was 49.5 years revealed that they had experienced their symptoms for an average of ten years. A relatively high percentage of the men reported that they were unmarried or unhappily married, whereas most of the women said that they had made satisfactory marital adjustments. The group appears to be slightly higher than the average with regard to vocational and educational achievements. Their hobbies were oriented about sedentary pursuits. Except for marital status, the group did not appear to be markedly deviant in the areas discussed in this section.

II. MENTAL FUNCTIONING

A. *Intellectual status*

The Wechsler-Bellevue Intelligence Scale, Form I, was used to test each patient prior to surgery. Test data were available on 112 patients and were analyzed in detail. Due to motor impairment, not all of the patients were able to perform each of the sub-tests of the scale. However, full-scale intelligence quotients involving both verbal and performance measures were available on 102 patients. In this group, the mean full-scale intelligence quotient was 100.9, with a verbal quotient of 104.5 and a performance quotient of 95.6. The distribution of the full-scale intelligence test scores according to a standard classification of intellectual functioning (6) may be seen in Table 4.

Analysis of these data reveals that the intelligence-test scores are distributed

TABLE 1. *Distribution of 108 Parkinsonian Patients According to Age*

Age (yrs.)	34–40	41–50	51–60	61–75
No. of patients	20	37	40	11

TABLE 2. *Marital Status of 36 Male and 23 Female Parkinsonian Patients*

	Male		Female		Total No.
	No.	Per cent	No.	Per cent	
Happy marriage	4	11	8	35	12
Adequate marriage	7	19	8	35	15
Married twice	3	9	2	9	5
Unhappy marriage	9	25	1	4	10
Unmarried	13	36	4	17	17
Total	*36*		*23*		*59*

may be seen that the marital patterns of the men differed somewhat from those of the women. Thus, 61 per cent of the men had never married or had been unhappily married, whereas only 21 per cent of the women reported this pattern. On the other hand, 70 per cent of the women claimed adequate or happy marriages, whereas only 30 per cent of the men claimed similar experiences. The effects of the disease on marital status appear to be pronounced, in that many of the males reported they never felt physically, psychologically and financially secure enough to support a wife because of parkinsonism. Many complained of shyness and isolation with regard to members of the opposite sex. Many of the unhappily married persons stated that the disease aggravated an already strained marital relationship.

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TABLE 4. *Classification of 102 Parkinsonian Patients According to Intelligence Levels*

Classification	Score	No. of Patients
Mental defective	65 or below	3
Borderline	66–79	3
Dull normal	80–90	11
Average	91–110	50
Bright normal	111–119	19
Superior	120 and over	10
		102

along a fairly normal curve. Some 2.7 per cent of the patients fell into the defective class and an equal number into the borderline group; 26 per cent scored bright-normal or higher. The full import of these scores is difficult to interpret because of a lack of detailed knowledge of the relationships between age and intelligence, and because of the absence of adequate norms for older age groups. At any rate, our group appeared to be of average intelligence and the test scores, for the most part, seem to be commensurate with the average or slightly higher than average educational and vocational achievements described previously.

There was some disparity between the scores on the verbal and performance sub-tests of the intelligence scale. However, the difference appeared to be smaller than one might expect, considering the severe motor disabilities present in so many of our patients. This finding may have been due to the fact that the performance tests were not "pure" measures of motor functioning.[1]

In a small percentage there was evidence of mental deterioration, in the sense that their over-all functioning on the test was markedly below what one would have been led to expect from their past educational and vocational attainments. No significant relationship was discovered between scores obtained on the intelligence scale and the severity or length of illness.

B. *Incidence of psychopathology*

A series of 114 patients was examined by means of clinical interviews, ward observations, life history data and a number of well-known psychologic tests, including the Wechsler-Bellevue Intelligence Scale, the Rorschach Ink-blot Test, the Draw-A-Person Test, the Bender-Gestalt, the Personal Preference Inventory (a modified version of the Thematic Apperception Test), and the Robinson-Freeman Measure of Self Continuity. Psychologic reports based on these findings were analyzed by 2 examiners who attempted to classify the group according to clinical entities. Their findings are presented in Table 5.

Analysis of these data reveals that 59 per cent of the patients were functioning within the normal or neurotic range. These patients frequently experienced

[1] Micrographia and other writing difficulties can be more adequately detected by other instruments such as the Bender-Gestalt and Draw-A-Person test. In addition, we have observed that in a handwriting test administered under different conditions, the Parkinsonian patient has great difficulty in slowing down his movements.

TABLE 5. *Status in Regard to Psychopathology in 114 Parkinsonian Patients*

	Number	Per cent
Normal-neurotic	68	59
Severely disturbed	24	21
Schizophrenic	6	5
Organic	16	14

anxieties and personal problems, but the degree of mental disturbance seemed to be appropriate to the hardships imposed by the disease. Twenty-one per cent of the patients were rated as severely disturbed. These included borderline psychotic conditions, free-floating anxiety states, severe obsessive compulsive character disorders, paranoid states, and severe chronic depressions.

Only 5 per cent of the 114 patients were overtly schizophrenic. Fourteen per cent demonstrated the effects of organic impairment on their behavior. Some of these patients appeared to be "organically" impaired because of the influence of medications. Mental disturbances apparently antedated the parkinsonism in some cases, but not in others; they were not significantly related to the length or severity of the motor symptoms. However, "organicity" was greater among the older patients than among the younger ones.

With regard to mental functioning, the intelligence test scores for the group were distributed along a fairly normal curve. The number of cases of mental deterioration was small. Most of the group appeared to be functioning in the normal or neurotic range insofar as clinical status is concerned. Approximately one fifth had marked psychologic disturbances. An additional fifth appeared sufficiently disturbed to be considered as demonstrating schizophrenia or an organic mental syndrome.

III. ASPECTS OF PERSONALITY

A. *Childhood factors*

Although the patients had a heterogeneity of early childhood experiences, several factors in this area seem worthy of discussion. A fairly large percentage seemed to have undergone early traumatic experiences. Thus, in a sample of 61 patients (40 men; 21 women) whose interviews were carefully examined, 23 (38 per cent) reported the death of one parent or the break-up of the family because of marital discord, before high-school age. This finding was noted in 45 per cent of the men and 28 per cent of the women. The patients reported their childhood to have been unhappy as often as they reported it to have been happy. The number of negative statements concerned with attitudes towards parents was more than the number of positive statements. This held true particularly for statements concerning the father. Almost twice as many patients regarded their fathers negatively as regarded them positively. Of 40 men, only 5 considered their fathers to be the strong effective figure in the household. As a group, the patients reported that they were closest to their mothers and that the mother figure was the dominant member of the family.

TABLE 6. *Patient's Opinion Regarding Cause of Illness in 51 Parkinsonian Patients*

	Men	Women
Physical illness	10	7
Accident or injury	5	3
Stress or worry	9	4
Childbirth	—	5
"Don't know"	7	1
Total	*31*	*20*

B. *Self-attitudes and values*

When the patients were presented with a task (7) requiring that they speak as long as they could on the following topics—1) your favorite season of the year, 2) a description of yourself now, 3) a description of yourself in childhood, and 4) changes you would like to see in yourself—the responses varied. In a sample of 42 patients, the needs most frequently cited were: a) the need to conform, b) the need to be liked, and c) the need to succeed. Specifically, 15 patients indicated that such things as maintaining moral values, believing in religion, and doing what society expects, were their primary style of adjustment. Another 14 indicated a strong need for affiliation and a desire to be liked, manifested by such statements as "People say I've got a sweet disposition;" "I'm good-natured;" "I never lose my temper;" or "I'm good to everybody."

Nine patients (20 per cent) stated that they were motivated by ambition, always attempted to do too much, or were perfectionistic. The statements of the remainder of the patients could not be classified without doing violence to the complexities of their life patterns. Thus, 1 patient with a paranoid adjustment remarked, "I always see things negatively . . . I'm afraid of criticism; they will laugh at me." Another patient with very low self-esteem commented, "I don't think my judgment is good," and refused to pursue the task at hand.

C. *Patient's opinion regarding cause of illness*

Patients were asked routinely their thoughts concerning the cause of their illness. The answers covered a wide range and, in some cases, were highly idiosyncratic. However, we were able to group the responses into several categories, as seen in Table 6.

In a sample of 51 patients, one third attributed their disease to earlier physical illnesses. Sixteen per cent believed that their disease was caused by an earlier accident, *e.g.*, "I jumped through a snow tunnel in childhood and my neck got out of joint"; or "I hurt my arm while golfing." One patient whose responses overlapped in several categories thought that his disease stemmed from occupational hazards. He was employed as a buyer of botanical wares and attributed his illness to the fact that he tasted bulbs which came from foreign, disease-ridden lands.

A large group of patients thought that the parkinsonism had developed be-

cause of psychologic pressures. These patients, numbering over a fourth of the sample, cited such factors as family problems, vocational stress, or war-time experiences as precipitating circumstances. One patient said that her shaking began because she was highly nervous about presenting a book review to her club. When she addressed the meeting, she noticed that her hand began to shake and her foot seemed to be "frozen." Another patient noted that, a few days prior to the onset of her first symptoms, she lost her voice for a 24-hour period following a family quarrel. We have not included in the group a few patients who seemed to implicate psychologic events, but not in such a direct manner. For example, with regard to guilt feelings over past misdeeds, 3 men thought their tremor was due to the fact that they had had intercourse with prostitutes many years before the onset of the disease.

Another category worthy of special note is that of the responses of 5 women (20 per cent) who attributed their disease to injuries of the sexual or reproductive organs. One woman stated that she knew something was wrong when she gave birth to her child many years ago.

Eight patients stated flatly that they did not know the cause of their disease and refused to speculate about it.

D. *Reactions to illness*

Almost all of the patients reported negative reactions to their illness, in the following order of frequency 1) self-consciousness, 2) withdrawal from outside social contacts, 3) irritability, 4) lability, 5) memory and thinking impairment, 6) resignation and 7) feelings of helplessness. The great majority of the patients reported being depressed and disturbed by their disease. However, numerous devices were utilized to protect the self-image and fight the symptoms—"When they stare, I stare right back at them;" "I sit on my hands to stop the shaking;" "You devise new schemes, but they last about a week and then you're licked. The shaking starts again." Several patients indicated that they felt more sympathy and identification with other disabled or underprivileged people. Although many wondered, "Why did it happen to me?", only 1 man described himself as bitter.

Few patients overtly denied their disease. Seven of the group used the defense of denial in more subtle ways, *e.g.*, refusal to accept the diagnosis, refusal to think about the situation, or unwillingness to concede the consequences of the diagnosis. One man in this group stated "Parkinson's disease has made me a fuller man. My mind is clearer. I now read more. If something can't be cured, it must be endured. It's only physical, not mental." One unusual reaction was that of a patient who was happy to hear that she had the disease because, "I thought I was a lazy good-for-nothing mother. I stopped being depressed because I knew it wasn't my fault." Patients appeared to vacillate between depression and denial, hope and resignation.

When an attempt was made to relate the findings in the area of reactions to illness with the findings pertaining to cause of illness, several patterns were uncovered. People who thought their disease was due to psychologic stress rather

than to physical illness or accident tended to report more than twice as many negative reactions in relation to the parkinsonism. This group tended also to experience feelings of self-consciousness and withdrawal more often than the "physical" or "accident" group.

An over-all picture of the data presented in this section can be brought into focus. Four areas relevant to adjustment in parkinsonism were examined: 1) childhood factors; 2) self-attitudes and values; 3) the patient's conception of the cause of the disease, and 4) his reactions to the illness. Our findings indicated a heterogeneity of responses in all of the areas. However, some trends were noted. A rather large number of the males reported that they came from broken homes with ineffective fathers and dominant mothers, and that their childhood was not experienced as an essentially happy period. The group characterized themselves as demonstrating the following needs in order of frequency: 1) need for conforming, 2) need to be liked, and 3) need for success. One third of the group thought that the disease was due to physical illness, nearly one sixth thought it was due to an accident, and one fourth thought it was due to psychologic stress. In addition, 5 women thought it was related to childbirth. The group saw their disease as unpleasant. Patients reported self-consciousness, withdrawal, irritability, crying spells, memory problems, resignation and helplessness as their main reactions to the illness.

DISCUSSION

Two questions are foremost at this point: 1) How are we to evaluate the significance of the data? 2) Are there any common factors which can mold the findings into meaningful gestalts? Our interpretation of the findings must take into account the conditions under which they were obtained. They were gathered from a group of patients who were seen within a week before operation and consequently were under some stress at the time of examination. In addition, some of the material presented refers back to childhood and is, therefore, subject to distortions of memory. However, the examiners noted that the patients were eager to cooperate and responded positively to the interviewers. Minimally, we can interpret the data in terms of how patients perceive, what they prefer to tell about their childhood, and the nature of their perception of the illness.

The relationship between the patients' statements and actual events cannot be answered definitively from our data, *e.g.*, answers pertaining to the cause of illness often revealed more about the concerns and anxieties of the patient than they did about the actual "causes" of the disease.

Because of the heterogeneity of responses in most areas under consideration, we were unable to conclude that there is a "parkinsonian personality type." However, we did note one pattern which appeared in a sub-group of 40 men. When we divided them into a group (17 men) stemming from broken homes as opposed to a group (23 men) originating from intact homes, some differences appeared in significant areas. In the group from broken homes, 46 per cent described their childhood as unhappy, 35 per cent felt their Parkinson's disease stemmed from psychologic tensions and 41 per cent noted that self-consciousness

and withdrawal were their primary reactions. In the group from intact homes, 15 per cent experienced their childhood as unpleasant, 4 per cent attributed the disease to psychologic factors, and 15 per cent noted that self-consciousness and withdrawal were their primary reactions to the illness. Our data suggest, therefore, that there may be patterns of response pertaining to childhood experiences and perceptions of disability.

A parallel series of findings is reported in the literature in another area of chronic diseases. Thus, studies in the field of arthritis indicate that nearly 50 per cent of the patients examined in three independent investigations reported the loss of one parent by the time adolescence was attained (8). This factor has caused speculations with regard to the high incidence of inadequate identification of the sex role in arthritic patients. In addition, a series of laboratory investigations has disclosed that subjects who perceive their fathers as mild and weak and their mothers as dominant exhibit a reaction which resembles the emergency type and seem to be more susceptible to stress (9). This reaction is manifested by a specific pattern of cardiovascular changes and a tendency to turn anger inward against the self in a frustrating situation. Thus, for arthritic patients, the hypothesis has been proposed (8) that adequacy of masculine identification, the reaction to stress, and the general response to chronic disease are interrelated.

SUMMARY

One hundred and eight parkinsonian patients have been evaluated with regard to three major areas: psycho-social background, mental functioning and personality patterns. The average age was 49.5 years, and the average duration of Parkinson's disease was 10.9 years.

The patients were slightly better than average in educational and vocational achievements. Among the 66 men, a relatively high percentage were unmarried or had experienced poor marital relationships. The group as a whole appeared to be of average intelligence, on the basis of test scores; 59 per cent were classified as normal or neurotic, 14 per cent as having mental deterioration and 5 per cent as schizophrenic.

Personality patterns were obtained from interviews and tests. Upon examination of the data, it was found that patients varied as to how they perceived their childhood, themselves, the cause of illness, and their reactions to it. The findings were too diverse to conceive of a "parkinsonian personality" or of a typical reaction to the disease. One pattern, however, was observed in a rather large percentage of the men who came from broken homes. There was a tendency for this group to describe their childhood as unhappy, to attribute the cause of illness to stress, and to emphasize withdrawal and self-consciousness in reaction to the disease. This finding warrants further investigation.

REFERENCES

1. Schwab, R. S., and Prichard, J. S.: Situational stresses and extrapyramidal diseases in different personalities, *in* Life Stress and Bodily Disease. Research Publ. Assoc. Nerv. & Ment. Dis. Baltimore, The Williams & Wilkins Co., 1950, vol. 29, pp. 48–60.
2. Booth, G.: Psychodynamics in parkinsonism, *Psychosom. Med.* **10:** 1–14 (Jan.–Feb.) 1946.

3. Diller, L.; Riklan, M., and Laszewski, Z.: Effects of anterior choroidal artery occlusion and of chemopallidectomy on the tremor and rigidity of Parkinson's disease: an independent appraisal, *J. Am. Geriatrics Soc.* **4:** 1246–1248 (Dec.) 1956.
4. Harrower, M., and Kraus, J.: Psychological studies on patients with multiple sclerosis, *A. M. A. Arch. Neurol. & Psychiat.* **66:** 44–57 (July) 1951.
5. Lorge, I.: Aging and intelligence, *J. Chronic Dis.* **4:** 131–140 (Aug.) 1956.
6. Wechsler, D.: The Measurement of Adult Intelligence. Baltimore, The Williams & Wilkins Co., 1944.
7. Robinson, M. F., and Freeman, W.: Psychosurgery and the Self. New York, Grune & Stratton, 1954.
8. King, S.H.: Psycho-social factors associated with rheumatoid arthritis, *J. Chronic Dis.* **2:** 287–302 (Sept.) 1955.
9. King, S. H., and Henry, A. F.: Aggression and cardiovascular reactions related to parental control over behavior, *J. Abnorm. & Soc. Psychol.* **50:** 206–211 (Mar.) 1955.

PREOPERATIVE RESPONSE TO STRESS AS A CRITERION OF THE RESPONSE TO NEUROSURGERY IN PARKINSON'S DISEASE

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In observing the outcome of neurosurgery in a variety of parkinsonian patients, wide differences in response patterns were noted. We wondered whether a systematic preoperative screening procedure would shed light on some of these patterns and also serve as a prognostic indicator of the outcome of neurosurgery. The necessity for such a procedure is important because success or failure of the therapeutic measure may depend not only on the alleviation of the symptoms, but on the adaptation to the cure. We were aware that the nature, locus and extent of the surgical lesion, as well as the conditions under which it was produced, accounted for much of the variance in the results. However, we wished to discover if any significant portion of the variance could be eliminated on the basis of data obtained by studying the relationship between preoperative findings and operative results.

One approach to the problem was suggested by a report that parkinsonian patients who could not tolerate stress responded poorly to various therapeutic techniques (1). In analyzing the conditions confronting a parkinsonian patient just prior to neurosurgery, our experience indicated that these conditions are perceived by him as quite stressful. Naturally, he is anxious, in view of the fact that he has presented himself for a new elective surgical procedure and has been informed of the mortality rate. The hospitalization and intensive preoperative examinations are anxiety-provoking in a person who has been forced into a sheltered, dependent existence because he is in an advanced stage of a chronic, progressive disease. Granted that the psychologic situation of the patient on preoperative testing is replete with anxiety, we can venture the following statements:

Parkinsonian patients may be classified on the basis of their reaction to a stressful situation. Those whose performance is impaired under stress will respond less well to: 1) brain surgery carried out under local anesthesia, 2) the tensions accompanying recuperation from the operation, and 3) the stimulation of a dynamic postoperative rehabilitation program. Preoperative response to stress should, therefore, be correlated with the postoperative outcome. There may be some support for this hypothesis in a recent study showing a relationship between anxiety and the outcome of (abdominal) surgery (2). The deduction may be recast into an hypothesis, which lends itself to operational analysis. Responses in the stress situation before surgery which are indicative of (a) perceptual regression, (b) perceptual rigidity, and (c) perceptual inefficiency are correlated with the judges' ratings of lowered postoperative functioning. The utilization of various dimensions of perceptual responses may be viewed as a highly refined observation of the individual's way of dealing with stimuli. Evidence for the

sensitivity of these responses to stress is presented in the following discussion of the criteria selected for this study.

PROCEDURE

Tests

1. *Perceptual regression*

Analysis of Rorschach-test responses, according to a scheme developed by Friedman (3), was based on the notion that mature perception undergoes three stages in development: 1) a primitive stage (marked by diffuse, syncretic, vague and labile prehension of experience), 2) an intermediate stage (marked by differentiation and articulation of discrete percepts), and 3) a mature stage (marked by the integration of experience into complex, synthesized gestalts). Recent studies indicate that this scheme is related to regression: (a) older children see more mature percepts on the Rorschach than do younger children (4); (b) with an increase in the psychopathologic condition, perception changes from the mature to the primitive stage (5); and (c) under conditions of laboratory stress, perception changes from the mature to the primitive stage (6). We reasoned that primitive perceivers were less likely to tolerate the stress of surgery than mature perceivers. Two judges applying this scheme to our data agreed in the scoring of 90 per cent of the responses yielded by 10 complete protocols drawn from our series in a random fashion. The reliability of the scoring seemed sufficiently secure. The percentage of mature responses was used as a measure of perceptual regression.

2. *Perceptual constriction or rigidity*

(a) *Necker cube and Schröder staircase* (7). These two figures are designed to elicit the number of figure-ground reversals seen within a given period of time. Ability to see the figures fluctuating is a "task requiring the individual to restructure the field more or less according to . . . subjective standards" (8). There are indications that the number of reversals in an ambiguous figure are not related to eye movements in a simple fashion (9). Several studies have indicated that these tasks are related to more central variables. Jones (10) noted that difficulties in reversing perspective occur more frequently among authoritarian people who are intolerant of ambiguity. Newbigging has demonstrated that changes in reversible figures are related to the ability to extract simple figures from more complex backgrounds (8). He attributes the "reversal of figures of reversible perspective" to "fluctuations of attention" (8) and adds, "Fluctuations of attention, which release central processes from immediate sensory control are a necessary antecedent to subjective restructuring of the perceptual field." Inability to perform this task appears to be related to inferior functioning and to a constricted range of experiencing stimuli. We reasoned that persons who could not tolerate stress would have greater difficulty in reversing the figures. Each figure was exposed three times for one-minute intervals. The reliability of this measure may be judged by the fact that the median intercorrelation between each trial within each figure was rho = .84 (P = .01).

(b) *Thurstone adaptation of Müller-Lyer illusion* (11). This procedure was utilized as another test of perceptual rigidity. The task requires the subject to compare the lengths of two lines masked by arrows pointing in different directions, *e.g.*, ←→. In a series of ten cards, the position of the center arrow is gradually moved, so that the line which is objectively larger at the beginning, becomes objectively smaller. The number of trials required to notice this shift is taken to be an index of perceptual rigidity. In this task, rigidity may be thought of as a delay in adapting to a changing stimulus, so that the individual clings to an hypothesis which was correct at one time, but is now false. Several recent studies (12) have indicated that individuals under threat cling to judgments which become incorrect with changing stimuli. We can thus expect threatened subjects to require more cards to be presented before a change is noted. The ten cards were presented twice. The number of cards needed to note the change was averaged for both trials. Correlation of the first trial with the second yielded a rho of .78 ($P = .01$).

3. *Perceptual efficiency*

(a) *Perceptual accuracy*. The Picture Completion subtest of the Wechsler-Bellevue Intelligence Scale requires the subject to note the missing parts of a picture. This task was utilized because it demands alertness and accuracy of perception. Korchin and Basowitz (13) have demonstrated that in a life-stress situation, *e.g.*, a parachute jump, responses become inefficient. Cohen, Senf and Huston (14) have demonstrated that in severe psychopathologic disturbances, perceptual inaccuracy occurs even in highly structured tasks. In order to have a control for the possibility that a person's intelligence level may be responsible for his score on this task and not his perceptual skill, the Picture Completion score (transformed into an intelligence quotient to allow for age) was divided by the "altitude" (the average of the three highest scores on the Wechsler-Bellevue Scale) (15). The resulting percentage was taken to be a measure of perceptual accuracy relative to a person's most advanced skills.

(b) *Perceptual satiation*. Several investigators have demonstrated that staring at a figure yields a perceptual after-effect which distorts the perception of a second figure. These findings hold true for normal subjects, but not for schizophrenics (16). The size of the after-effects appear to be positively related to learning indices (17) and negatively related to personality rigidity (17). Various observers have attempted to utilize the degree of figural after-effect as a measure of brain functioning. Although some have reported conflicting results in applying this measure to subjects with brain injuries (18, 19), the phenomenon has been correlated with some measures of metabolic efficiency (20). We reasoned that preoperative failure to demonstrate figural after-effect should be related to poor operative outcome, because of impairment of metabolic efficiency (20) or because of rigidity (17). We used a task requiring the subject to stare at a card, then stare at a second card and finally examine the degree of distortion that the second one contributed to the perception of the first one when the latter was presented again. The procedure duplicates that described by Wertheimer (16).

Criterion

The basic pool from which our subjects were drawn consisted of 112 patients whose postoperative status in regard to tremor and rigidity has been described in other papers (21, 22). The criterion was the sum of the scores in 3 discrete areas of functioning which were rated independently by at least 3 (in some instances, 5) judges. The areas included the postoperative status of 1) tremor and rigidity, 2) the ability to perform basic skills in activities of daily living, and 3) the mental condition. These tests furnished a composite index of cognition (memory and orientation), depression (affect and irritability) and motivation (effort and initiative). Each patient was rated as either +1 (improved), 0 (same), or −1 (worse), in each of the areas involved. Thus, a patient whose motor disturbance was alleviated, who could perform more activities of daily living, and in whom there was no sacrifice of higher mental proceses or élan, would receive a score of +3. A patient who sustained a hemiplegia so that he could not perform activities of daily living and appeared to be mentally confused, would receive a score of −3. In this manner, it was possible to achieve an over-all rating on a scale ranging from +3 to −3. All percentages of agreement between raters for each of the areas was significant at the .02 or .01 levels of confidence.

Experimental Design

All subjects were patients with Parkinson's disease, and they were tested before operation. Since three distinct surgical procedures were under consideration (anterior choroidal artery occlusion, subtemporal chemopallidectomy and transfrontal chemopallidectomy), it was decided to separate the subjects undergoing one procedure from those undergoing another because: 1) the procedures might not have been equally effective, and 2) the results of one type of surgery could serve as cross-validation for the findings attending the other two types, thus leading to a more economic and meaningful experimental design. The numbers and classifications of the patients undergoing the various tests in our study are shown in Table 1.

Because of administrative considerations, it was not possible to subject all the patients to as many of the tests as we would have wished. Rank-order correla-

TABLE 1. *Distribution of Patients Undergoing Various Perceptual Tests Prior to 3 Different Neurosurgical Procedures, for Whom Preoperative Test Scores and Postoperative Ratings Were Available*

Test	Anterior Choroidal Artery Occlusion	Subtemporal Chemopallidectomy	Transfrontal Chemopallidectomy	Total
Perceptual regression (Rorschach)	13	35		48
Perceptual rigidity (cube)		29	22	51
Perceptual rigidity (staircase)		30	19	49
Perceptual rigidity (arrows)		31	20	51
Perceptual accuracy (picture completion)	10	27	15	52
Perceptual satiation (figural after-effects)		26	13	39

TABLE 2. *Rank-Order Correlations Between Preoperative Perceptual Measures and Postoperative Ratings of Over-all Outcome of Neurosurgery*

Preoperative Test	Over-all Outcome		
	Anterior Choroidal Artery Occlusion	Subtemporal Chemopallidectomy	Transfrontal Chemopallidectomy
Perceptual satiation (Rorschach)	.53 (P = .05)	.26 (P = .08)	
Perceptual accuracy (cube)		.43 (P = .02)	.58 (P = .01)
Perceptual rigidity (staircase)		.40 (P = .02)	.40 (P = .06)
Perceptual rigidity (picture completion)	.72 (P = .02)	.42 (P = .01)	.56 (P = .03)
Perceptual rigidity (arrows)		.27	.27
Perceptual regression (figural after-effects)		.43 (P = .03)	.37

tions were computed between the scores on each test and the over-all and discrete scores of the criterion. This statistical tool was used in preference to the product-moment correlation because the assumptions demanded by the latter, *e.g.*, normal distribution of scores, would not be warranted by our data.

RESULTS

In Table 2 it may be seen that operative results were indeed related to preoperative measures of perception. All correlations were in the predicted direction, and 10 of the 13 were significant at the .08 level or less. All of the values appeared to be significant on both initial trials and cross-validation, except for the arrows and the figural after-effect. Results of both of these tests, however, were in the direction predicted and, with use of a liberal one-tailed test, they approached significance even on cross-validation.

It would also appear, that the preoperative measures were correlated significantly with the results following all three types of brain surgery. In the subtemporal chemopallidectomy group, 14 patients underwent all the tests. A test of significance, designed by Blomqvist (23) to indicate whether a number of measures hang together and are therefore related to a common underlying factor, yielded a t of 6.8 (P = .001). In the transfrontal chemopallidectomy group, 10 patients underwent all the evaluation procedures. The Blomqvist test yielded a t of 1.86 (P = .10).

When individual correlations were tabulated between results in the individual preoperative tests and in each of the three postoperative areas rated in regard to motor symptoms, activities of daily living and mental status, none of the areas yielded as many significant correlations as those obtained by relating the tests to the over-all outcome. It should be noted, however, that the number of significant correlations between the findings in the mental area and the results of the preoperative tests approached a high degree of significance; 8 of 13 correlations were significant at the .10 level of confidence. Thus, preoperative results are probably more closely related to the postoperative variable of mental status than to the postoperative motor symptoms or postoperative performance of the activities of daily living.

DISCUSSION

In appraising our findings, two questions seemed pertinent—one practical, the other theoretical: 1) How should these results be utilized by the neurosurgeon? 2) How can we arrive at a concept of the relationship between two such seemingly divergent phenomena as response to a perceptual task and the outcome of neurosurgery?

On the basis of our data it appears that the physician can use these results to help him understand some of the complex conditions which can effect the outcome of surgery in Parkinson's disease. Although the test results may foretell the outcome to a significant extent, they should be used as specific prognostic indicators with some caution, since 1) the base rates of surgical success (24) for different types of surgery vary so much that it is difficult to set up absolute cut-off points on scores derived for one surgical situation and expect them to hold for others and 2) the decision to perform a neurosurgical operation is a function of a complex set of conditions, including non-psychologic factors, and perceptual responses may be only one of several types of psychologic response related to the outcome of surgery. We have found perceptual indices most useful when (a) the scores are highly deviant, and/or (b) social, physical and other psychologic factors raise doubts about the feasibility of the patient as a candidate for surgery.

In trying to formulate the reasons for the significant correlations obtained in our study, our thinking was stimulated by observations of patients in response to life stress (1). However, the concept of stress as a psychologic phenomenon is not entirely clear. An individual's response to a given situation is a function of at least 1) the nature of the task requirements, 2) his perception of the meaning of the situation, and 3) his level of personality organization (25). In analyzing the nature of the responses to the stimuli in our test situation, we reasoned that 1) the tasks were sensitive to important nuances in response tendencies, 2) although the meaning of the situation might be interpreted differently according to the projections of each individual, the threat posed by the operation and hospitalization was strong enough to arouse anxiety in all of the patients, and 3) under conditions of threat, more central and basic personality variables were called into play (25). Consequently, the responses elicited in our situation are highly significant. They point to some important parameters of personality integration. For this reason, they may be related to adaptations in important life situations.

It is difficult to say whether or not the correlation between preoperative test responses and surgical outcome was due to the fact that both measures were sensitive to maladaptive habits formed to deal with stress, or that both measures reflected deficiencies in biologic integration. Some of the measures that were used in this study are explicitly anchored in theories involving functioning of the brain (8, 17, 20), and others in personality deviation (3, 10).

There are many theories concerning the relationship between behavior, perception and biologic functioning. One theory in particular deserves mention in this context. Mettler (26) has proposed that perceptual organization is a function of physiologic conditions. Schizophrenia is a disorder of perception, influenced by dysfunction of the basal ganglia. He suggests several behavioral similarities

between schizophrenia and Parkinson's disease and speculates that the physiologic pathology of the two disorders is similar. Perhaps the patients who responded poorly in our test situation were suffering from schizophrenia as well as Parkinson's disease. As a matter of record, the Rorschach measure used in this study was originally designed to demonstrate perceptual regression in schizophrenia (3).

SUMMARY

Preoperative measures of the responses to perceptual tasks for parkinsonian patients undergoing anterior choroidal artery occlusion, subtemporal chemopallidectomy or transfrontal chemopallidectomy proved to be significantly related to the outcome of the surgery.

The tasks included a Rorschach measure of perceptual regression, ability to reverse a reversible cube and staircase, ability to recognize a change in slowly shifting stimuli, ability to identify missing parts of an incomplete picture, and a measure of distortion due to visual satiation. Of the 13 rank-order correlations that were computed, all were in the predicted direction, and 10 were significant at the .08 level or better. With regard to the outcome of neurosurgery, the tasks predict postoperative mental status better than they predict the status of the motor disorder and the ability for self-care.

Careful evaluation of personality is a distinct aid in the selection of parkinsonian patients for neurosurgery.

REFERENCES

1. Schwab, R. S., and Prichard, J. S.: Situational stresses and extrapyramidal diseases in different personalities, *in* Life Stress and Bodily Disease. Research Publ. Assoc. Nerv. & Ment. Dis., 1950, vol. 29.
2. Herring, F. H.: Psychological study of patient response during surgery and anesthesiology, *Psychosom. Med.* (in press).
3. Friedman, H.: Perceptual Regression in Schizophrenia: An Analysis by Means of the Rorschach Test Ph.D. Dissertation, Clark Univ., Worcester, Mass., 1950.
4. Hemmindinger, L.: A Genetic Study of Structural Aspects of Perception as Reflected in Rorschach Responses Ph.D. Dissertation, Clark Univ., Worcester, Mass., 1951.
5. Siegel, E. L.: Genetic Parallels of Perceptual Structurization in Paranoid Schizophrenia: An Analysis by Means of the Rorschach Technique Ph.D. Dissertation, Clark Univ., Worcester, Mass., 1951.
6. Lofchie, S. H.: The performance of adults under distraction stress; a developmental approach, *J. Psychol.* **39:** 109–116, 1955.
7. Woodworth, R. S.: Experimental Psychology. New York, Henry Holt, 1938.
8. Newbigging, P. L.: The relationship between reversible perspective and embedded figures, *Canad. J. Psychol.* **8:** 204–209, 1954.
9. Hakerem, G.; Bean, A., and Sutton, S.: The relationship of eye movements to reversals of an ambiguous figure, *Am. Psychologist* **11:** 431, 1956.
10. Jones, M. B.: Authoritarianism and intolerance of fluctuation, *J. Abnorm. & Soc. Psychol.* **50:** 125–127, 1955.
11. Thurstone, L. L.: A Factorial Study of Perception. Chicago, Chicago Univ. Press, 1947.
12. Moffitt, J. W., and Stagner, R.: Perceptual closure and rigidity as functions of anxiety, *J. Abnorm. & Soc. Psychol.* **52:** 354–357, 1956.
13. Korchin, S. J., and Basowitz, H.: Perceptual adequacy in a life stress, *J. Psychol.* **38:** 495–502, 1954.

14. COHEN, B. D.; SENF, R., AND HUSTON, P.: Perceptual accuracy in schizophrenia, depression and neurosis, and effects of Amytal, *J. Abnorm. & Soc. Psychol.* **52:** 371–376, 1956.
15. JASTAK, J.: Psychometric personality traits, *Delaware State Med. J.* **21:** 165–169, 1949.
16. WERTHEIMER, M.: The differential satiability of schizophrenic and normal subjects: a test of a deduction; the theory of figural after-effects, *J. Gen. Psychol.* **51:** 201–299, 1954.
17. WERTHEIMER, M.: Theories and facts about individual differences in figural after-effects, *Am. Psychologist* **11:** 420, 1956.
18. KLEIN, G. S., AND KRECH, D.: Cortical conductivity in the brain injured, *J. Person.* **21:** 118–148, 1952.
19. JAFFE, R.: Constant errors in the measurement of figural after-effects, *Am. J. Psychol.* **67:** 543–550, 1954.
20. WERTHEIMER, M.: Figural after-effects as a measure of metabolic efficiency, *J. Person.* (in press).
21. DILLER, L., AND RIKLAN, M.: Psychosocial factors in Parkinson's disease, *J. Am. Geriatrics Soc.* **4:** 1291–1300 (Dec.) 1956.
22. DILLER, L.; RIKLAN, M., AND LASZEWSKI, Z.: Effects of anterior choroidal artery occlusion and of chemopallidectomy on the tremor and rigidity of Parkinson's disease: an independent appraisal, *J. Am. Geriatrics Soc.* **4:** 1246–1248 (Dec.) 1956.
23. MOSTELLER, F.: Statistical theory and research design, *Annual Rev. Psychol.* **4:** 407–435, 1953.
24. MEEHL, P. E., AND ROSEN, A.: Antecedent probability and the efficiency of psychometric signs, patterns, or cutting scores, *Psychol. Bull.* **52:** 194–217, 1954.
25. KOROBOW, N.: Reactions to stress: a reflection of personality trait organization, *J. Abnorm. & Soc. Psychol.* **51:** 464–469, 1955.
26. METTLER, F. A.: Perceptual capacity, functions of the corpus striatum and schizophrenia, *Psychiat. Quart.* **29:** 89–111, 1955.

EFFECTS OF LESIONS IN THE PUTAMEN ON INVOLUNTARY MOVEMENTS AND RIGIDITY IN PARKINSON'S DISEASE

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In spite of invaluable experimental evidence, our knowledge of the pathophysiology of involuntary movements is still in an unsettled state. Animal experiments with lesions in the basal ganglia have been few, and when they have been reduplicated in man they have not always produced identical results. Experimental neurophysiology in man is still inconclusive.

The continued accumulation of clinical data is therefore justifiable in helping to bring about a better understanding of the mechanism of tremor and rigidity. One avenue of investigation in this direction is injection of procaine into various subcortical structures in selected cases of hyperkinetic diseases.

Such injections have been made into the globus pallidus in more than 200 cases during the course of chemopallidectomy. Results in cases of Parkinson's disease and other hyperkinetic disorders have been reported previously.

During the course of the development of chemopallidectomy, injection of the putamen was performed in 6 cases. The effect of injecting procaine into the putamen was distinctly different from that achieved by injecting procaine into the globus pallidus. Whereas pallidal procainization resulted in alleviation of contralateral tremor and rigidity, injection of procaine into the putamen resulted in marked exacerbation of tremor and rigidity; in 2 instances, the tremor was temporarily transformed into choreoathetotic movements. It is the purpose of this paper to record our clinical observations following the injection of procaine or alcohol into the putamen in 6 cases of hyperkinetic disorders. Two cases, representative of the 6, are described.

CASE REPORTS

Case 1

M.B., a 48-year-old white male clerk noted the gradual onset of stiffness in his right hand and fingers in 1944, followed three years later by a resting tremor starting in the right fingers. Within five years the rigidity had become generalized, so that there was bradykinesia, loss of associated automatic movements, masked facies, kyphosis and a festinating gait. There was a history of encephalitis at the age of 8 years. Neurologic examination on admission revealed typical parkinsonian tremor and rigidity involving all four limbs, but especially the upper extremities. He had a propulsive gait, masked facies and bradykinesia.

A left chemopallidectomy was performed on June 24, 1955 following a partial pneumoencephalogram. The cannula was inserted by the usual technique through the transtemporal approach under local anesthesia. The first placement was inaccurate and the tip of the catheter was seen to be in the putamen, 2 mm. behind the plane of the anterior commissure and just lateral to the external border of part II of the globus pallidus. Procaine (0.25 cc. of 1 per cent solution) was injected in .05-cc. increments, with the catheter in this position. Following each injection there was an exacerbation of tremor in the right upper extremity which was different in character from the preoperative tremor, in that it was more choreoathetotic and violent. This tremor was not constant, was precipitated by peripheral stimuli

and excitement, and was transitory. The catheter was subsequently reinserted into the left globus pallidus and injection of procaine was followed by complete relief of the tremor and rigidity of the right extremities.

Case 2

A.O., a 48-year-old coal miner gave a history of the onset of stiffness in the right hand and fingers in 1944, gradually progressing to involve the right leg within a few months. The left side became involved three years later, so that he was forced to give up his job. Tremor was first noted in 1953, starting in the right hand and fingers. This tremor became generalized within six months, although remaining much more severe in the upper limbs. He had influenza at the age of 14 years. Neurologic examination revealed typical parkinsonian tremor and cogwheel rigidity; both were generalized, but much more severe in the upper extremities especially on the right side. The rest of the neurologic examination confirmed the presence of the other stigmata of Parkinson's disease.

On February 10, 1955, a left transfrontal chemopallidectomy was performed by the usual technique, following a preliminary partial pneumoencephalogram under local anesthesia. Injection of procaine into the globus pallidus resulted in relief of contralateral tremor and rigidity. This was followed by an injection of 0.5 cc. of absolute alcohol and the wound was closed with the catheter in place. Three days later, x-ray examination revealed that the catheter had been partially displaced so that its tip lay in the medial portion of the putamen in the plane of the anterior commissure (Fig. 1). Absolute alcohol (0.1 cc.) was injected into this site. Immediately there was an increase in the rigidity of the right upper extremity accompanied by an exacerbation of the tremor involving the right arm, hand and fingers. Again the tremor was of the choreoathetotic type and did not last for more than a few minutes. The catheter was subsequently reinserted into the left globus pallidus, and the injection of alcohol was followed by relief of the tremor and rigidity of the right side.

THE PUTAMEN

The term basal ganglia has been used to designate all subcortical motor nuclei of the forebrain, including the caudate nucleus, putamen and globus pallidus, these being closely linked functionally with several brain stem nuclei, namely, the corpus luysi, substantia nigra, and the reticular formation (17, 40). The nomenclature of these basal ganglia is confusing. In this paper, we use the term striatum or neostriatum to include the caudate nucleus and putamen in instances in which a more specific reference to the individual nucleus is not possible. It is the general belief at the present time that although the caudate nucleus and the putamen are partly separated by the internal capsule they are continuous with one another ventrally; they resemble each other in internal structure and form a structural unit characterized by striations (40).

Phylogenetically, there is a close parallelism between the development of the striatum and the isocortex, the striatum being primarily an intraforebrain association center, in contrast to the pallidum, which retains its ancestral function as a motor nucleus and develops along with the allocortex.

Anatomy

The putamen is lateral to the internal capsule and the pallidum, which separate it from the thalamus (40). The lateral surface of the putamen is covered by the external capsule, which separates it from the claustrum and the overlying insula Along its ventrolateral border extends the uncinate fasciculus and farther back is

FIG. 1. Pneumoencephalogram Case #2, demonstrating position of cannula in the putamen.

seen the lateral olfactory nucleus, which is related to the ventral border of the claustrum and the frontal end of the amygdala. In the region of the amygdala, the lower part of the putamen forms an enlarged quadrilateral base known as the peduncle of the putamen. It is joined by the tail of the caudate nucleus and can be regarded as an expanded portion of the tail under the putamen. The dorsal edge of the putamen lies against the internal capsule. Its medial surface encloses the outer surface of the pallidum.

Histologically, the putamen and caudate nucleus are characterized by bundles of fibers which radiate through a homogeneous cellular mass containing a moderate amount of myelinated neuropil. The cells consist of a large number of small stellate neurons and less numerous neurons of medium size. The proportion of small neurons to the medium sized neurons is about 20 to 1.

Blood supply

The striatum, with the exception of the postero-ventral recurved part of the tail of the caudate nucleus and the adjoining postero-ventral crest of the putamen, receives its blood from the striate arterioles (40). In two thirds of the cases the arterioles for the antero-medio-ventral tip of the head of the caudate nucleus and the putamen are derived from the anterior cerebral artery, and those for the remaining portions of the caudate and putamen from the middle cerebral artery. The postero-ventral crest of the putamen is usually supplied from the anterior choroidal artery. In contrast to the opinion of some authors who regard the putamen as less vascular than the parietal and other parts of the cortex, Alexander (1) found that the putamen and caudate nucleus exceeded in capillary density all other parts of the cortex, being surpassed only by the lateral geniculate bodies, paraventricular nuclei and a few other nuclei of the brain stem. His findings show that the capillary density is greatest in the putamen, less in the motor area, still less in the insular cortex, and least in the globus pallidus.

Afferent connections

Earlier workers noted that the anatomic connections of the striatum with the cortex were not well defined, although at that time changes in the striatum in experimental animals and in man were noted by some workers when portions of the cerebral cortex were removed (40, 46). The earlier reports on corticostriate connections were conflicting. Thus Economo (12), Ramon y Cajal, (45), Minkowski (36), Igarasi (23), and Mettler (32, 33) reported such connections, whereas Poliak (43), Wilson (56), and Verhaart and Kennard (53) questioned such connections. This conflict was perhaps due to the fact that the earlier investigators were all using the Marchi technique. Glees (20) reported that in using the Marchi method in experimental animals, he was unable to find any degeneration of the myelin content of the caudate nucleus after lesions were made in the motor and all other areas of the cerebral cortex. In view of the electrophysiologic evidence (11) of the existence of connections between the suppression areas and the striatum, Glees reasoned (as did Dusser de Barenne and McCulloch (10) before him) that if there were afferent connections between the cortex and the striatum, they must be sought in nonmyelinated fibers. By a silver impregnation technique, Glees was able to show that the areas of suppression (2-s, 3-s, and 8-s) in the cat's brain are connected with the caudate nucleus by nonmyelinated cortico-caudate fibers arising as collaterals from the cortifugal fibers, and that the motor cortex has no direct connection with the caudate nucleus.

The putamen receives fibers from cortical areas 4 and 6 (17), possibly through the external capsule from the corpus callosum and lower frontal cortex (40). Thalamo-striate fibers (38–40) have been described in lower animals and in man as coming from the central medial nucleus of the thalamus. Most of the fibers were found terminating in the head of the caudate nucleus. Some observers (49) have traced thalamo-striate fibers to both the caudate nucleus and the putamen from the dorsal thalamus. The Dejerines have described a strio-thalamic group of fibers arising from the caudate and the putamen. However, Wilson (56)

failed to trace any degeneration spreading into the thalamus from lesions strictly confined to the putamen. The striatum also receives fibers from the subthalamic nucleus and from the substantia nigra through the nigrostriate fibers (47, 48). These nigrostriatal fibers were formerly described as entirely strionigral in origin (40, 49), springing mostly from the caudate nucleus but with some fibers from the putamen. The putamen also receives fibers from the pallidum (49) and from the nucleus caudatus (56). A few fibers pass from the putamen to the caudate but the number is much less than in the reverse direction (56).

Efferent connections

Wilson (56), the Vogts (54), Spiegel (51), Jacob (24), Winkler (58) and Poliak (43) believed that efferent fibers arising in the caudate and putamen end entirely in the globus pallidus, whereas Rundles and Papez (49), the Dejerines (6), and Foix and Nicolesco (15) felt that there are both striopallidal and direct strionigral pathways. According to the first view, both the caudate and the putamen discharge through the globus pallidus, which in turn sends a motor projection to the thalamus and (via the ansa lenticularis) to the substantia nigra, corpus luysi and the reticular formation (17).

Physiology

The physiologic evidence of the connections between the cortex and the basal ganglia is more impressive, and was demonstrated much earlier than the anatomic connections. By strychninization of areas 4, 4-s, 6 and 8-s in the monkey's brain and by recording the electrical activity, Dusser de Barenne *et al.* (11) postulated that the so-called area 4-s sends axons to the nucleus caudatus but not to the putamen or globus pallidus, that area 6 sends axons to the putamen and to the external segment of the globus pallidus but not to the caudate nucleus, and that area 8-s (like area 4-s) sends axons to the nucleus caudatus but not to the putamen or globus pallidus. Except in 1 animal, no cortical area behind the sulcus centralis has ever fired any part of the corpus striatum. No strychninization of any part of the corpus striatum has ever fired any part of the cortex from area 9 to area 19 inclusive.

Results of stimulation in animals

Poggio and associates (42) in their study of cortical after-discharge through the subcortical structures in experimental animals found that the after-discharge induced by electrical stimulation of the motor cortex evokes consistently a concomitant discharge in the ipsilateral putamen. It would seem from their studies that the entire putamen is fired upon stimulation of any part of the motor cortex. In fact, in 95 per cent of cases in which the after-discharge has been produced, there is a concomitant involvement of the ipsilateral putamen. In contrast to the findings of others (50), Poggio *et al.* were able to observe activity in the putamen, globus pallidus or caudate following only 10 per cent of their stimulations of the temporal cortex. Faeth and associates, following 5 of 8 injections of procaine penicillin G in oil into the putamen of experimental animals, noted

focal motor seizures, four of which were contralateral and one ipsilateral. Abnormal electroencephalograms were observed in association with 7 of these injections, although in 2 animals no clinical seizures were observed. The clinical attacks and EEG abnormalities were indistinguishable from those attributed to seizures of cortical origin. Kopeloff and associates (30) reported that status epilepticus developed about five weeks after one of their animals had received bilateral injections of alumina cream into the putamen. Kennard (27) also noted generalized seizures following bilateral ablation of area 6 and the caudate, and bilateral ablations of area 8 and the putamen, but this finding was inconsistent.

Early attempts to stimulate the basal ganglia brought conflicting results largely because phasic movements were sought, rather than changes of posture. Thus Wilson (56) found the putamen and caudate nucleus of monkeys completely inexcitable when stimulated with an intensity greater than that adequate for the motor cortex. However, if the extremity happened to be maintaining a posture, stimulation of the caudate nucleus caused a prompt inhibition of the posture. Similarly Kennard and Fulton (25) showed that unilateral or bilateral removal of the caudate nucleus or putamen (either simultaneously or serially) did not have any effect on the motor performance of monkeys. When the responsiveness of the basal ganglia is examined against a background of either posture or concurrently induced movements from the cerebral cortex, it has been found that stimulation of the striatum causes a vigorous inhibitory response. Primary movements are never obtained, but somatic motor actions initiated by the cortex can be dramatically inhibited by even a weak stimulation of the striatum (32, 52). These reactions are nonobtainable if the caudate nucleus has been previously destroyed. Primary lesions of the caudate or putamen without injury to the cortex cause inconspicuous motor deficit (10, 47). Only when combined with lesions of the cortex is the deficit grave. Thus, when any one of the motor regions 4, 4-s and 6 is extirpated from the cortex, and at the same time or subsequently the caudate nucleus or putamen be ablated, the symptoms characteristic of injury in that cortical area are always more pronounced and enduring (27).

Electroencephalogram in human subjects

Electroencephalograms (21) obtained in human subjects with bipolar leads made by passing electrodes through burr holes into the subcortical structures (*e.g.*, caudate nucleus, putamen, medial segment of globus pallidus, or cingulate gyrus) showed no obvious characteristics of frequency, amplitude or wave forms which could be regarded as distinctive for any of the anatomic structures explored. The recordings resembled each other closely.

Lesions of the putamen in human subjects

A search in the literature for the results of lesions confined solely to the putamen in man is not rewarding, because reports of isolated pathologic changes in the putamen alone are few. Alexander (2) reported the case of a 51-year-old male chronic alcoholic with a history of increasing ascites for six months and jaundice for three weeks. During the third week of hospitalization, rhythmic tremors

developed in the hands, lips and tongue. Necropsy revealed symmetrical necrosis of the anterior half of the putamen bilaterally. Davison and Goodhart (4) reported the case of a 41-year-old woman with monochorea limited to the right upper extremity. Autopsy revealed a partial lesion of the left putamen and caudate nucleus. Although the striatum is commonly damaged in chorea (9, 22, 24, 28, 29, 54), many investigators deny that chorea can result from the destruction of any single neural structure (35, 57). However, patients in whom lesions involving the putamen are found at necropsy are not always afflicted during life by involuntary movements.

Lesions of the putamen in animals

A review of investigations in animals shows that involuntary movements have been observed following lesions in the striatum. Thus, Wilson (56) noted that occasionally certain movements occurred while the putamen of experimental animals was being explored with the needle of the Horsley-Clarke stereotaxic apparatus. These movements were always variable, inconsistent and fleeting. Kennard (27) was able to produce an activity tremor in monkeys lasting as long as two years whenever a large unilateral lesion was made in the caudate and putamen (caudate alone was not sufficient), in the putamen, or in the putamen and globus pallidus. This tremor was bilateral and could be increased by subsequent removal at a second operation of either the contralateral area from the basal ganglia or from area 6 of the cortex. The most marked tremor occurred following combined lesions of area 6, 8, and the head of the caudate nucleus. However, tremor at rest (resembling that of paralysis agitans) has been produced by other workers in experimental animals by means of lesions in areas other than the basal ganglia, namely, the mesencephalic and pontine tegmentum (55, 41), lateral cerebellar nuclei, and the subthalamus (41). Because of the reference of lesions precipitating postural tremor to the reticular formation of the brain stem, Magoun (31) raised the possibility that this tremor is due to an abnormal timing of reticulo-spinal impulses passing to the spinal cord.

Choreiform and athetoid movements in experimental animals have been reported following lesions confined to the caudate nucleus alone, and following lesions in the caudate nucleus or putamen accompanied by ablation of areas 4 and 6. Such movements were transient and difficult to reproduce. In contrast to tremor, which was bilateral even after unilateral lesions, choreoathetotic movements were contralateral to the basal ganglia lesions (27). Spasticity did not appear as a result of isolated lesions of the basal ganglia but only when cortical area 6 was damaged in addition. Removal of area 6 and one of the basal ganglia (putamen, caudate nucleus, or globus pallidus) produced a greater spasticity than removal of area 6 alone. True chorea has been difficult to produce in experimental animals.

Localization of function (tremor)

The bilaterality of function of the basal ganglia and the lack of localization of function within the nuclei is almost complete with regard to tremor in experi-

mental animals (27). Choreoathetotic movements are contralateral to the basal ganglia lesions, in contrast to tremor, which is bilateral even following unilateral lesions.

Kleist (29) felt that there was somatotopic localization in the putamen—the arm, face, and voice being represented in the medial anterior part of the putamen, the trunk and legs being represented posteriorally. This concept is supported by the findings in our 2 cases and in Alexander's case (cited previously). His patient was a chronic alcoholic with tremor involving the hands, arms, lips and tongue; at necropsy there was necrosis of the medial part of the anterior half of the putamen. Similarly, in Davison and Goodhart's (4) case of monochorea limited to the right upper extremity, there was a partial lesion of the putamen and caudate anteriorally at autopsy. These authors also postulated that there was somatotopic localization in the striatum, the extreme oral pole being associated with the muscles of the head and face, the middle part with the muscles of the upper extremity and trunk, and the caudal part with the muscles of the lower extremity.

DISCUSSION

Although concrete experimental experience in the human subject has heretofore been lacking, there is considerable pathologic evidence that some degree of atrophy of the putamen is often associated with choreiform movements of the contralateral extremities. Moreover, Adams[1] has reported a case in which there was atrophy of the putamen associated with marked rigidity of the contralateral extremities. Thus, there is some basis for the conclusion that the contralateral choreiform movements and/or rigidity which occurred immediately following injection of procaine into the putamen, in the patients reported here, were causally related to this surgical procedure. We are not, however, in a position to delineate the mechanism underlying the production of these hyperkinetic phenomena.

SUMMARY

In 6 patients undergoing brain surgery for parkinsonism, small quantities of procaine or alcohol were injected into the putamen. In each instance the injection was followed immediately by choreiform movements or rigidity of the contralateral extremities. These exaggerated hyperkinetic phenomena disappeared spontaneously within periods varying from fifteen minutes to seventy-two hours, or were abolished by subsequent injections of alcohol into the globus pallidus.

REFERENCES

1. Alexander, L.: The vascular supply of the strio-pallidum, *in* Diseases of the Basal Ganglia. Publ. A. Research Nerv. & Ment. Dis. (Proc., 1940) 1942, vol. 21, pp. 77–132.
2. Alexander, L.: The fundamental types of histopathologic changes encountered in cases of athetosis and paralysis agitans, *in* Diseases of the Basal Ganglia. Publ. A. Research Nerv. & Ment. Dis. (Proc., 1940) 1942, vol. 21, pp. 334–493.
3. Clark, W. E. L.: Observations on the efferent connexions of the centre median nucleus, *J. Anat.* (London) **73**: 225–262, 1939.

[1] Adams, R.: Personal communication to I.S.C.

4. Davison, C., and Goodhart, S. P.: Monochorea and somatotopic localization, *Tr. Am. Neurol. A.* pp. 106–110, 1939; *Arch. Neurol. & Psychiat.* **43:** 792–803, 1940.
5. Davison, C.: The role of the globus pallidus and substantia nigra in the production of rigidity and tremor. A clinico-pathological study of paralysis agitans, *in* Diseases of the Basal Ganglia. Publ. A Research Nerv. & Ment. Dis. (Proc., 1940) 1942, vol. 21, pp. 267–333.
6. Dejerine, J., and Mme. Dejerine-Klumpke: Structure et connexions du corps strie, *in* Anatomie des Centres Nerveux. Paris, J. Rueff, 1895–1901, vol. III, p. 816; vol. I, p. 720.
7. De Jong, R. N.: The Neurological Examination. Chap. 22. Tne extrapyramidal level. New York, Paul B. Hoeber, 1950, pp. 362–382.
8. Denny-Brown, D.: The Diseases of the Basal Ganglia and Subthalamic Nuclei, *in* Oxford Loose-Leaf Medicine. New York, Oxford Univ. Press, 1945, vol. 6, chapt. 11, pp. 261–302.
9. Dunlap, C. B.: Pathologic changes in Huntington's chorea with special reference to the corpus striatum, *Arch. Neurol. & Psychiat.* **18:** 867–943, 1927.
10. Dusser de Barenne, J. G., and McCulloch, W. S.: Factors for facilitation and extinction in the central nervous system, *J. Neurophysiol.* **2:** 319–355, 1939.
11. Dusser de Barenne, J. G.; Garold, H. W., and McCulloch, W. S.: Physiological neuronography of the cortico-striatal connections, *in* Diseases of the Basal Ganglia. Publ. A. Research Nerv. & Ment. Dis. (Proc., 1940) 1942, vol. 21, pp. 246–266.
12. Economo, C. von: Beitrag zur Kasuistik und zur Erklarung der posthemiplegischen Chorea, *Wien klin. Wchnschr.* **23:** 429–431, 1910.
13. Economo, C. von: Über dissoziierte Empfindungslahmung bei Ponstumoren und über die zentralen Bahnen des sensiblen Trigeminus, *Jahrb. f. Psychiat.* **32:** 107–108, 1911.
14. Faeth, W. H.; Walker, A. E., and Warner, W. A.: Experimental subcortical epilepsy, *A. M. A. Arch. Neurol. & Psychiat.* **75:** 548–562, 1956.
15. Foix, C., and Nicolesco, J.: Anatomie cérébrale: les noyaux gris centraux et la région mésencéphalo sous optique suivi d'un appendice sur la maladie de Parkinson. Paris, Masson & Cie, 1925.
16. Fulton, J. F.: Functional interrelation of cerebral cortex with basal ganglia and cerebellum, *in* Essays in Biology. Berkeley, Univ. of California Press, 1943, pp. 201–212.
17. Fulton, J. F.: Textbook of Physiology. Chap. 17. Basal Ganglia and Cerebellum. Philadelphia, W. B. Saunders. Co., 1955.
18. Garol, H. W.: The motor cortex of the cat, *J. Neuropath. & Exper. Neurol.* **1:** 139–145, 1942.
19. Garol, H. W.: The functional organization of the sensory cortex of the cat, *J. Neuropath. & Exper. Neurol.* **1:** 321–329, 1942.
20. Glees, P.: The anatomical basis of cortico-striate connexions, *J. Anat.* (London) **78:** 47–51, 1944.
21. Hayne, R.; Myers, R., and Knott, J. R.: Characteristics of electrical activity of human corpus striatum and neighboring structures, *J. Neurophysiol.* **12:** 185–195, 1949.
22. Hunt, J. R.: Progressive atrophy of the globus pallidus, *Brain* **40:** 58–148, 1917.
23. Igarasi, Y.: Ueber die Faserverbindung des vorderen Teiles der lateralen Grobhirnhemisherenflache bei der Ziege. *Gegenbaurs morpholog. Jahrbuch* **84:** 108–153, 1939–40.
24. Jakob, A.: The anatomy, clinical syndromes, and physiology of the extrapyramidal system, *Arch. Neurol. & Psychiat.* **13:** 596–620, 1925.
25. Kennard, M. A., and Fulton, J. F.: Cortico-striatal interrelations in monkeys and chimpanzee, *in* Diseases of the Basal Ganglia. Publ. A. Research Nerv. & Ment. Dis. (Proc., 1940) 1942, vol. 21, pp. 228–245.
26. Kennard, M. A.: Cortical reorganization of motor function, *Arch. Neurol. & Psychiat.* **48:** 227–240, 1942.
27. Kennard, M. A.: Experimental analysis of the function of the basal ganglia in monkeys and chimpanzees, *J. Neurophysiol.* **7:** 127–148, 1944.

28. KLEIST, K.: Zur Auffassung der subcortikalen Bewegungestorungen, *Arch. f. Psychiat.* **59:** 790–804, 1918.
29. KLEIST, K.: Gehirn-Pathologie vornehmlich, auf Grund der Kriegsfahrungen, *aus* Hdbch. d. ärztlichen Erfahrungen im Weltkriege, Band IV, Tl. 2: Geistes- und Nervenkrankheiten (xv and pp. 343–1048). Barth, Leipzig, 1934.
30. KOPELOFF, N.; WHITTIER, J. R.; PACELLA, B. L., AND KOPELOFF, L. M.: The epileptogenic effect of subcortical alumina cream in the rhesus monkey, *Electroenceph. & Clin. Neurophysiol.* **3:** 163–168, 1950.
31. MAGOUN, H. W.: Caudal and cephalic influences of the brainstem reticular formation, *Physiol. Rev.* **30:** 459–474, 1950.
32. METTLER, F. A.; ADES, H. W.; LIPMAN, E., AND CULLER, E. A.: The extrapyramidal system, *Arch. Neurol. & Psychiat.* **41:** 983–995, 1939.
33. METTLER, F. A.: Relation between pyramidal and extrapyramidal function, *in* Diseases of the Basal Ganglia. Publ. A. Research Nerv. & Ment. Dis. (Proc., 1940) 1942, vol. 21, pp. 150–227.
34. MINGAZZINI, M.: Das Mittelhirn, *aus* von Mollendorf: Handbuch der mikroskopischen Anatomie des Menschen. Berlin, Julius Springer, 1928, pp. 644–673.
35. MINKOWSKI, M.: Experimentelle und anatomische Untersuchungen zur Lehre von der Athetose, *Ztschr. f. d. ges. Neurol. u. Psychiat.* **102:** 650–718, 1926.
36. MINKOWSKI, M.: Étude sur les connexions anatomiques des circonvolutions rolandiques, parietales et frontales, *Schweiz. Arch. f. Neurol. u. Psychiat.* **15:** 97–132, 1924.
37. PAPEZ, J. W.: Reciprocal connections of the striatum and pallidum in the brain of Pithecus (Macacus) rhesus, *J. Comp. Neurol.* **69:** 329–349, 1938.
38. PAPEZ, J. W.: Thalamic connections in a hemidecorticate dog, *J. Comp. Neurol.* **61:** 433–475, 1938.
39. PAPEZ, J. W., AND RUNDLES, R. W.: Thalamus of a dog without a hemisphere due to a unilateral congenital hydrocephalus, *J. Comp. Neurol.* **69:** 89–102, 1938.
40. PAPEZ, J. W.: A summary of fiber connections of the basal ganglia with each other and with other portions of the brain, *in* Diseases of the Basal Ganglia. Publ. A. Research Nerv. & Ment. Dis. (Proc., 1940) 1942, vol. 21, pp. 21–68.
41. PETERSON, E. W.; MAGOUN, H. W.; MCCULLOCH, W. S., AND LINDSLEY, D. B.: Production of postural tremor, *J. Neurophysiol.* **12:** 371–384, 1949.
42. POGGIO, G. F.; WALKER, A. E., AND ANDY, O. J.: The propagation of cortical afterdischarges through the subcortical structures, *A. M. A. Arch. Neurol. & Psychiat.* **75:** 350–361, 1956.
43. POLIAK, S.: The Main Afferent Fiber Systems of the Cerebral Cortex in Primates. Univ. of California Publ. in Anatomy, Vol. II. Berkeley, Univ. California Press, 1932.
44. POLLAK, E.: Der amyostatische Symptomenkomplex and verwandte Zustande, *Deutsche Ztschr. f. Nervenh.* **74:** 8–47, 1922.
45. RAMON Y CAJAL, S.: Textura del sistema nerviosa del hombre y de los vertebrados. Madrid, N. Moya, 1897–1904.
46. RANSON, S. W.; RANSON, S. W., JR., AND RANSON, M.: Corpus striatum and thalamus of a partially decorticate monkey, *Arch. Neurol. & Psychiat.* **46:** 402–415, 1941.
47. RANSON, S. W., AND RANSON, S. W., JR.: Efferent fibers of the corpus striatum, *in* Diseases of the Basal Ganglia. Publ. A. Research Nerv. & Ment. Dis. (Proc., 1940) 1942, vol. 21, pp. 46–76.
48. ROSEGAY, H.: An experimental investigation of the connections between the corpus striatum and the substantia nigra in the cat, *J. Comp. Neurol.* **80:** 293–310, 1944.
49. RUNDLES, R. W., AND PAPEZ, J. W.: Connections between the striatum and the substantia nigra in a human brain, *Arch. Neurol. & Psychiat.* **38:** 550–563, 1937.
50. SEGUNDO, J. P.; NAQUET, R., AND ARANA, R.: Subcortical connections from the temporal cortex of the monkey, *A. M. A. Arch. Neurol. & Psychiat.* **17:** 515–524, 1955.
51. SPIEGEL, E.: Die Kerne im Vorderhirn der Sauger, *Arb. a. d. neurol. Inst. a. d. Wien. Univ.* **12:** 418–497, 1919

52. Tower, S., and Hines, M.: Dissociation of the pyramidal and extrapyramidal functions of the frontal lobe, *Science* **82:** 376, 1935.
53. Verhaart, W. J. C., and Kennard, M. A.: Cortifugal degeneration following thermocoagulation of areas 4, 6 and 4-s in Macaca mulatta, *J. Anat.* (London) **74:** 239–254, 1940.
54. Vogt, C., and Vogt, O.: Zur Kenntnis der pathologischen Veranderungen des Striatum und des Pallidum und zur Pathophysiologie der dabei auftretenden Krankheitserscheinungen, Sitzungsb. d. Heidelberger Akad. d. Wissensch. *J. f. Psychol. u. Neurol.* (Leipzig) **25:** 633, 1920.
55. Ward, A. A.; McCulloch, W. S., and Magoun, H. W.: Production of an alternating tremor at rest in monkeys, *J. Neurophysiol.* **11:** 317–330, 1948.
56. Wilson, S. A. K.: An experimental research into the anatomy and physiology of the corpus striatum, *Brain* **36:** 427–492, 1913–14.
57. Wilson, S. A. K.: Modern Problems in Neurology. New York, William Wood and Co., 1929.
58. Winkler, C.: Manuel de neurologie. Tome I. L'anatomie du système nerveux. Partie 5. Le corps strié et le diëncéphale. Haarlem, de Ervin F. Bohn, 1933.

Abstracts of Current Literature

THE SIMULTANEOUS OCCURRENCE OF DUODENAL AND GASTRIC ULCER DURING THERAPY WITH ACTH. A REPORT OF TWO CASES.

Baroody, W. G., and Shugart, R. T. *Am. Pract. & Digest Treat.* **6:** 1876 (Dec.) 1955.

This is the first report of the simultaneous occurrence of duodenal and gastric ulcer during the administration of ACTH. These ulcers occurred in 2 patients under treatment for Boeck's sarcoid. Neither patient had a history suggestive of peptic ulcer. Roentgenograms prior to therapy showed no abnormalities. In the first patient, the initial dosage was 20 mg. intravenously daily for twenty-eight days followed by 15 mg. daily for six days, and then 10 mg. daily for five days. Treatment was discontinued during the fifth week because of burning epigastric pain. Histamine gastric analysis showed 88 and 92 units of free hydrochloric acid in the 45-minute and 60-minute specimens, respectively. The gastric ulcer was initially overlooked on the roentgenogram. With a bland diet, antacids, and antispasmodics, the ulcers healed in six weeks. Treatment in the second patient with the same initial dosage of ACTH had to be discontinued after one week because of severe epigastric pain, anorexia, and melena. Histamine gastric analysis showed 95 units of hydrochloric acid in the 45-minute specimen. With anti-ulcer therapy, the ulcers healed in three weeks as shown by roentgenographic examination. These acute ulcerations were regarded as "stress lesions" which could be effectively treated. Ulcer prophylaxis is advised in the administration of adrenocortical steroids. A bland diet is essential, with interval and bedtime feedings, supplemental antacids, and anticholinergic agents in patients receiving prolonged steroid therapy and in those with a history of peptic ulcer.

PHLEBITIS; A STUDY OF 748 CASES AT THE BOSTON CITY HOSPITAL.

Byrne, J. J. *New England J. Med.* **253:** 579 (Oct. 6) 1955.

Experience at the Boston City Hospital has been contrary to the growing impression that division of the proximal veins in patients with phlebitis is of doubtful value in preventing pulmonary embolism. A study was conducted in 748 patients with phlebitis in whom leg signs preceded pulmonary embolism. Eighty-three per cent of the patients were over age 40. The incidence was greatest in patients from age 50 to 79 years. The mortality rate increased up to age 50 and then remained constant. The sex distribution was approximately equal. The mortality rate was 19 and 23 per cent for males and females, respectively. The incidence of phlebitis during the ten years covered by the study increased from 1.3 to 3.9 per 1,000 admissions. No seasonal variation of the disease could be found. The predisposing conditions with their percentage frequency were: cardiac disease, 28; postoperative complication, 23; trauma, 11; idiopathic manifestations, 6.5; infection, 6.3; varicose veins, 5.4; childbirth, 5.4; hemiplegia, 5.0; carcinoma, 3.7; miscellaneous conditions, 4.0. Cardiac disease was the most significant of these. Heart disease was present in 73 per cent of the cases of fatal pulmonary emboli. The reason for postoperative phlebitis may be venous stasis, changes in the intima produced by the aging process or by trauma during the operative period, or increased coagulability of the blood secondary to dehydration, anemia, infection, necrosis or carcinoma. The most common trauma was fracture of the femur. The cause of phlebitis in the idiopathic group may have been related to minor trauma or effort. The most common infection was pneumonia, with tuberculosis second. Grade 1 phlebitis, which is sometimes called phlebothrombosis, was associated with 53 per cent mortality. Byrne believes that all phlebitis is the same process with varying manifestations. He, therefore, does not separate phlebothrombosis. The mortality was 31 and 29 per cent, respectively, in grades 3 and 4 phlebitis but these lower rates offer no reassurance that a pulmonary embolism will not occur. The mortality rate with various methods of treatment was as

follows: conservative (347 cases), 37 per cent; surgical (369 cases), 2.1 per cent and anticoagulant (32 cases), 29 per cent. Among the surgical patients, primary division of the vena cava was performed in 7 and bilateral femoral-vein division in the remainder. The data support the following conclusions: bilateral division of the superficial femoral veins should be performed as soon as the diagnosis of phlebitis is made. If there are signs in the thigh (edema, tenderness, and evidence of trauma) the common femoral vein should be divided. When clots are adherent or difficult to extract, further treatment, as with anticoagulants or ligation of the vena cava, is indicated. Phlebitis should be actively treated before embolization occurs, inasmuch as 84 per cent of the initial emboli in this series were fatal. The postphlebitic syndrome is associated with the severity of phlebitis rather than with the type of treatment.

GALLSTONE ILEUS. A REPORT OF 12 CASES.

Deckoff, S. L. *Ann. Surg.* **142:** 52 (July) 1955.

Although the incidence of gallstone ileus is low, the condition should be suspected in cases of progressive intestinal obstruction in elderly, obese females in whom no obvious cause is apparent. Gallstone ileus is a disease of the elderly and occurs more frequently in women. The pathogenesis and pathologic changes are discussed. A previous history of gallbladder disease is found in about 50 per cent of patients. Symptoms of acute cholecystitis preceding the onset of gallstone ileus are uncommon. The initial episode of pain may be difficult to interpret. Often it occurs only when the stone has entered the alimentary canal and caused intestinal colic. As the stone traverses the small intestine, it causes partial, intermittent obstruction with cramps, nausea and vomiting. When the stone becomes wedged, the symptoms are those of complete small-bowel obstruction—cramps, nausea, vomiting, distention and obstipation. An intragastric stone may cause symptoms of intermittent pyloric obstruction. Tenesmus is the common complaint when a stone lodges in the rectal ampulla. A history of biliary colic is suggestive of the diagnosis. A mass is rarely palpable. The temperature and leukocyte count are usually normal or slightly elevated. Metabolic alkalosis with marked hypochloremia, moderate hyponatremia, mild hypokaliemia, and markedly elevated carbon dioxide combining power may be present. The most valuable aid to diagnosis is roentgenographic examination. Flat, upright, and lateral films of the abdomen are taken and, in addition, spot films of the liver region. The site of obstruction may be suggested and occasionally the stone visualized, although these stones are not ordinarily radiopaque. Air or constrast medium outlining the biliary tree furnishes presumptive evidence of a fistula connecting the biliary and gastro-intestinal tracts and is of diagnostic significance. By the proper correlation of data, a preoperative diagnosis may be made in about 50 per cent of cases. The treatment of choice is enterotomy, with removal of the stone after the patient has been properly prepared for surgery. The use of a long intestinal tube may be helpful in these patients, making it possible to delay the operation slightly. The mortality rate is high but it is gradually becoming equal to that of intestinal obstruction of other etiology in the elderly. Fourteen cases of gallstone ileus are reported in which the offending stone was removed. Death occurred in only 1 patient—a mortality rate of 7.1 per cent.

PENTOLINIUM AND HEXAMETHONIUM COMBINED WITH RAUWOLFIA IN THE TREATMENT OF HYPERTENSION.

Dennis, E.; Ford, R.; Herschberger, R., and Moyer, J. H. *New England J. Med.* **253:** 597 (Oct. 6) 1955.

The blood-pressure response in 75 patients who had received Rauwolfia combined with hexamethonium for twelve to eighteen months was compared during the last three to six months of this period with the response to Rauwolfia in combination with pentolinium (Ansolysen). Response was considered to be a reduction of 20 mm. of mercury or more in

the mean pressure in the upright position. The blood pressure was considered normal if the average reading was 150 systolic, 100 diastolic, or less. If either figure was exceeded, the pressure was not considered normal. Hexamethonium and pentolinium were first administered in small doses and then the dosage increased until an optimal blood-pressure reduction was attained or side-effects prohibited further increase in dosage. The percentage of patients responsive to therapy was 76 for Rauwolfia with hexamethonium and 79 for Rauwolfia with pentolinium. The percentages of patients normotensive under the two kinds of therapy were 37 and 33, respectively. Twelve patients not responsive to the first combination responded to Rauwolfia combined with pentolinium. The reverse was true in 10 patients. The results indicate that hexamethonium and pentolinium have similar effects. Pentolinium is, however, six to seven times more potent, as an average daily dose of only 341 mg. was required whereas a dose of 2,307 mg. of hexamethonium was required. Undesirable effects attributable to Rauwolfia such as bradycardia, nasal congestion, increased appetite, weight gain, and sedation were similar in the two treatment periods. Dizziness on standing and constipation, associated with ganglionic blockade, were present in comparable numbers of patients but were less intense following Rauwolfia combined with pentolinium. A second group of 35 patients received only Rauwolfia with pentolinium. Seven of them failed to experience an adequate blood-pressure response to Rauwolfia alone. In the others, severe hypertension required combination therapy. Ninety-four per cent of this group responded to treatment, and 41 per cent became normotensive. Commencing therapy of hypertension with Rauwolfia alone avoids subjecting responsive patients with mild hypertension to more intensive therapy. A ganglion-blocking agent can be added if additional therapy is necessary. Through its additive effect, Rauwolfia permits the use of a lower dosage of the ganglion-blocking agent. The blood-pressure reduction with Rauwolfia in combination with ganglionic blockade is orthostatic and can be corrected, if too great, by having the patient lie down. The response to norephinephrine is not lost, so that excessive hypotension can be readily combatted.

THE USE OF METHAMPHETAMINE HYDROCHLORIDE IN STOKES-ADAMS DISEASE.
Diamond, S., and Flaxman, N. *Am. Pract. & Digest Treat.* **6:** 1174 (Aug.) 1955.

Two cases of Stokes-Adams disease following acute myocardial infarction were treated with methamphetamine hydrochloride (Desoxyn) by injection. In the first patient, a man in whom the syncope and convulsions occurred on the seventh hospital day in the absence of shock, 120 mg. seemed to bring about a cessation of the attacks. In the second patient, a woman in profound shock the day after an acute myocardial infarction, a dose of 300 mg. was injected over a 16-hour period, and seemed especially effective when given intravenously during cardiac standstill. Both patients recovered and showed no ill effects from the use of this sympathomimetic drug. (From authors' summary)

HISTOLOGIC CHANGES WITHIN THE CHOROID PLEXUS OF THE LATERAL VENTRICLE: THEIR RELATION TO AGE.
Dunn, J., Jr., and Kernohan, J. W. *Proc. Staff Meet., Mayo Clin.* **30:** 607 (Dec. 14) 1955.

Study of the choroid plexus from 324 brains obtained at necropsy, when death occurred at varying ages from birth through 100 years, disclosed certain regressive histologic changes: 1) flattening of the covering ependymal cells, with an increase in the number of vacuoles and deposits of lipoid pigment, was found with aging; 2) proliferation of connective tissue and formation of hyaline plaques in varying stages of calcification occurred within the stroma of pial origin in the villi; 3) cellular proliferation, hyaline and fatty degeneration, and formation of psammoma bodies and cysts took place within the arachnoidal stroma of the centrum or body of the plexus—changes similar to those reported by other observers as oc-

curring elsewhere in the arachnoidea; and 4) vascular changes consisted of intimal thickening and medial fibrosis. The study indicated that these regressive changes occur frequently and increase with age although they are not limited to any given age. Because of their frequency, they should be included in any consideration of the normal histology of the choroid plexus. (From author's summary and conclusions)

PENTAERYTHRITOL CHLORAL: A NEW AGENT FOR HYPNOSIS AND SEDATION. PRELIMINARY REPORT.

Gatski, R. L. *Am. Pract. & Digest Treat.* **6:** 1885 (Dec.) 1955.

In a two-year study of 200 inmates of a psychiatric hospital, all standard hypnotic preparations available at the time showed various disadvantages. Pentaerythritol chloral, a new derivative of chloral, was then tested in 108 ward patients of another institution. The series included persons of all ages from childhood to senility; all were under treatment for organic or functional physical or mental disorders, or chronic alcoholism. The hypnotic dose for adults ranged from 0.5 to 1 Gm. (7.5 to 15 grains, average 10 grains), and for children from 0.3 to 0.6 Gm. (5 to 10 grains). Medication was continued nightly for periods of two weeks. The dose was repeated in two or three hours, if required. In all except 3 instances, one dose was sufficient. The control group (totaling 231) included the same patients, who received in control periods, placebos, chloral hydrate and barbiturates, and 123 additional hospitalized patients (senile, chronically ill, and alcoholic). With pentaerythritol chloral an average of two hours more sleep was obtained with quarter to half the usual dose of chloral hydrate, and the disadvantages of both chloral hydrate and the barbiturates were avoided. Hypnotic action was more rapid than that induced by the various dosage forms of chloral hydrate. Pentaerythritol chloral was administered to 43 patients (senile, middle-aged, young adults, and children) for performance of encephalographic studies. There were 82 controls who received barbiturates or chloral hydrate. Sleep was obtained in fifteen to twenty minutes, was more natural than in the controls, permitted rapid interruption without after-effects, and the electroencephalographic tracings showed no apparent "dampening." The control patients, on awakening, were drowsy and poorly co-ordinated, and a "dampening" effect on the sleep records was observed. One hundred patients who received 0.3 Gm. of pentaerythritol chloral every four to six hours for daytime sedation were satisfactorily relaxed but not drowsy. No untoward systemic or other side reactions occurred. Hence, the preparation may be used in the presence of heart, liver and kidney damage, and in alcoholic rehabilitation. For prolonged hypnotic or sedative medication of unstable patients in private practice, pentaerythritol chloral is preferable to barbiturates, since this agent may be prescribed with less risk of suicide. One of the great advantages of this drug in general practice, therefore, is the safety factor. (From author's summary)

COEXISTENT TUBERCULOSIS AND CARCINOMA OF THE LUNG.

Hauser, H., and Glazer, N. M. *Radiology* **65:** 680 (Nov.) 1955.

Ten cases of concomitant pulmonary tuberculosis and carcinoma of the lung are presented. The radiographic finding which suggested the presence of carcinoma in each instance is pointed out. Interpretation of these findings was aided by a review of the literature to determine the features that might suggest that tuberculosis was complicated by carcinoma and by the review of 250 unselected cases of tuberculosis to see whether or not these features were present in cases of tuberculosis alone. The study indicates that in patients with pulmonary tuberculosis, the following roentgenographic findings should suggest the possibility of the coexistence of lung carcinoma: unilateral prominence of the hila; a hilar measurement (over-all length of both hili) exceeding 13 cm.; paratracheal lymph node enlargement; the presence of an atelectactic or collapsed lobe or segment, in which mottling, linear streaking and cavitation, or both, are not seen, the density being essentially homogeneous; a

"spread of disease" in which the character of the infiltration is homogeneous, especially if it is in the lower lung fields; and a nodular density greater than 3 cm. in diameter, especially if it is in the lower lung fields.

ROENTGEN ABNORMALITIES OF THE LARGE AND SMALL INTESTINE ASSOCIATED WITH PROLONGED CATHARTIC INGESTION.

Heilbrun, H., and Bernstein, C. *Radiology* **65:** 549 (Oct.) 1955.

Roentgenographic findings in the bowel of 9 individuals who had ingested irritant cathartics daily for fifteen years or more resembled those of enterocolitis. The symptoms differed from those of inflammatory conditions, in that diarrhea, cramps, and blood in the stool were absent. There were no amoebae in the stools and results of proctoscopic examinations were negative. Neither was there evidence of ulceration. The rectum and sigmoid colon were not involved. The changes could therefore be attributed to cathartic ingestion. The active ingredients of the preparations used were stimulant or irritant cathartics. The sites of action of the mild and more severe of the irritating drugs corresponded to the locations of the roentgenographic findings. These active principles act directly upon the mucosa of the small and large intestine. Reflexly, their irritant action stimulates increased muscular activity and tonus. The hypertonicity impairs the motility of the bowel. When persistent, constipation develops as the result of incoordinated motility patterns with reduction in amplitude and frequency, and therefore slowed intestinal transport. A vicious cycle is established by the need for daily ingestion of a muscular irritant strong enough to stimulate the musculature of the bowel reflexly to overcome the incoordinated muscular action due to hypertonicity.

LABORATORY STANDARDS FOR OLDER PATIENTS.

Hodges, J. H. *Pennsylvania M. J.* **58:** 1119 (Oct.) 1955.

This editorial summarizes changes in the values for laboratory studies with age, and cites 40 references. The following changes with age are listed: decrease in weight of the thyroid, pancreas, spleen, brain, liver and adrenal gland; decrease in the amount of red bone marrow; decrease in hemoglobin values for males after age 60 with little change in the values for females; slight decrease, if any, in erythrocyte counts; a mean hematocrit of 42 for males and 40 for females; no significant changes in reticulocyte percentage, erythrocyte corpuscular constants and fragility; total leukocyte counts of 7,000 to 8,000 with no alteration in the differential count and morphology; serum iron levels of 85 and 80 mg. for males and females, respectively, at age 65; decrease in blood volume with decreased physical activity; increase in the percentage of fat in the total body weight as measured in men; decline in oxygen consumption of the body after age 20; decrease in basal heat production; the unreliability of basal metabolism figures for individuals over the age of 65; peak serum cholesterol values in males between the ages of 50 and 60 with a rapid decline thereafter; serum cholesterol values in females equal to those in the male by the fifth decade with gradual increase thereafter; decreases in serum protein-bound iodine level after age 60 and 70 in males and females, respectively; a precipitous drop in thyroidal radioactive iodine uptake in males at age 50, and a sharp rise in the female at the menopause with a sharp drop thereafter; gradual decrease in urinary 17-ketosteroids in both sexes; decline in androgen excretion after age 40 in both sexes; decline in estrogen excretion in women from the third to the sixth decades, with a constant low output thereafter; a peak in results of renal function tests in the third decade with decline thereafter in effective renal plasma flow, glomerular filtration, tubular function, and urea clearance; evidence of impairment of liver function beyond the age of 60; higher values in the glucose tolerance test after age 40; gradual decrease in total gastric acidity and an increase in the incidence of achlorhydria with age; more abnormalities in the electrocardiogram; a greater incidence in older persons of slow waves in the electroencephalogram; and low plasma levels of certain vitamins.

RESECTION OF RUPTURED ANEURYSMS OF THE ABDOMINAL AORTA.

Javid, H.; Dye, W. S.; Grove, W. J., and Julian, O. C. *Ann. Surg.* **142:** 613 (Oct.) 1955.

Rupture is the most frequent cause of death in abdominal aortic aneurysm. Because of this, it is probably wise to remove aneurysms of the aorta and replace them with grafts, even though the remainder of the aorta is diseased and the vascular system is arteriosclerotic. Probably a major proportion of patients with rupture survive for a sufficient length of time for surgical measures to be carried out. In a series of 22 resections of abdominal aortic aneurysm with graft replacement, 4 emergency operations were performed because of rupture. These 4 cases are presented and discussed. The diagnosis of rupture depends upon acute abdominal, flank and back pain, the presence of a growing abdominal mass *which pulsates*, and a falling blood count. Resection and replacement by a graft was performed in the 4 patients, with a fatality in 2 and complete restoration of the abdominal aorta in the other 2. In 3 of the 4 patients, the symptoms had been present for seven to thirteen days, and in 1 patient for sixteen hours. Death occurred in one patient following cardiac arrest despite successful resuscitation, and in the other following shock induced by secondary free intraperitoneal hemorrhage from retroperitoneal hematoma immediately prior to operation. The urgency for operation was emphasized by a similar occurrence just after the abdomen had been opened in a patient who survived.

CHOLECYSTECTOMY IN PATIENTS WITH CORONARY HEART DISEASE.

Keys, J. R.; Dry, T. J.; Walters, W., and Gage, R. P. *Proc. Staff Meet., Mayo Clin.* **30:** 587 (Dec. 14) 1955.

Among the records of 5,891 patients undergoing cholecystectomy, 100 were found wherein a diagnosis of coronary heart disease had been made prior to surgery. These were studied to determine the operative risk of cholecystectomy for patients with coronary heart disease, and whether the removal of a diseased gallbladder influenced the subsequent course of the patient. The patients tolerated the surgical procedure well and no deaths or serious complications occurred during operation. Three patients died postoperatively, 1 from acute pancreatitis on the fourth day, 1 from pancreatic necrosis on the twenty-first day after surviving a pulmonary embolus on the seventh day, and 1 on the seventeenth postoperative day. The third patient had cardiac failure and suffered from a cerebrovascular accident earlier in the postoperative course, but neither seemed to account directly for death. The postoperative morbidity rate was not unusual for intra-abdominal procedures in patients of the age of those in the group. All were over age 40 years of age, and 90 were above 50 years. One patient had an acute myocardial infarction following operation, from which he recovered. Two others had clinical and electrocardiographic evidence of acute coronary insufficiency during their hospital stay. The six-year survival rate was 70.6 per cent as compared with 83.9 per cent in the normal population of similar sex and age distribution. The study establishes the relatively low risk of cholecystectomy in patients with symptomatic coronary heart disease. The deaths from pancreatitis emphasize the dangers from complications of chronic biliary disease. They must be considered as even more serious in patients with coronary heart disease. By removing the gallbladder, the serious complications of biliary disease may be prevented and life prolonged, but it is doubtful whether the course of coronary heart disease is influenced by cholecystectomy.

COLLATERAL CIRCULATION OF THE EXTERNAL CAROTID ARTERY AND THE INTERNAL CAROTID ARTERY THROUGH THE OPHTHALMIC ARTERY IN CASES OF INTERNAL CAROTID ARTERY THROMBOSIS. REPORT OF FIVE CASES.

Lin, P. M., and Scott, M. *Radiology* **65:** 755 (Nov.) 1955.

Five cases are presented of internal carotid artery occlusion in which the diagnosis was established by angiographic demonstration of anastomosis of the external carotid artery

and the internal carotid artery above the site of occlusion through the retrograde circulation in the ophthalmic artery of the same side. In order to diagnose internal carotid artery occlusion, the vessel must sometimes be exposed by operation. Even then, the obstruction may escape detection if it is higher than the site of exposure. Therefore, when a carotid angiogram suggests an occlusion of the internal carotid artery, an attempt should be made to establish the presence of a collateral circulation from the opposite internal carotid artery and from the vertebral artery by carotid angiography on the opposite side, followed by vertebral angiography if necessary. With diminished pressure in the internal carotid artery as a result of occlusion, retrograde flow may take place in the ophthalmic artery. Therefore, visualization of the ophthalmic artery through its choroidal plexus anastomosing with the branches of the external carotid artery is a good indication of internal carotid occlusion proximal to the ophthalmic artery.

THE RELATIONSHIP OF CIRRHOSIS OF THE LIVER TO HYPERTENSION: A STUDY OF 504 CASES OF CIRRHOSIS OF THE LIVER.

Loyke, H. F. *Am. J. M. Sc.* **230:** 627 (Dec.) 1955.

On the basis of an analysis of the records of 504 cases of cirrhosis of the liver, it is concluded that 1) hypertension does not usually occur in the presence of cirrhosis, 2) hypertension may occur in cirrhotics in association with the development of renal disease, 3) stressful stimulation may produce temporary hypertension in cirrhotics, 4) established hypertension may be reversed to normal pressure with the onset of cirrhosis, and 5) coincidental reversal of the A/G ratio may occur with return of the blood pressure to normal range. (From author's conclusions)

CLINICAL VALUE OF A TRACING OF FORCED EXPIRATION (EXPIROGRAM). II. CARDIAC DISEASE.

Michaelson, A. L.; Franklin, W., and Lowell, F. C. *New England J. Med.* **253:** 852 (Nov. 17) 1955.

The application of a kymographic tracing obtained during the measurement of the vital capacity in the diagnosis and treatment of patients with cardiac disease is discussed. The vital-capacity determination alone is well known to be helpful in proper management and control of such patients. Inclusion of a measure of the speed of airflow during determination of the vital capacity is far more informative than the vital capacity alone, or than recordings of volumes expired during arbitrarily selected intervals. (From authors' summary).

OBSERVATIONS ON THE MECHANISM OF INTRANASAL ABSORPTION OF VITAMIN B_{12} IN PERNICIOUS ANEMIA.

Monto, R. W., and Rebuck, J. W. *Blood* **10:** 1151 (Nov.) 1955.

Satisfactory clinical and hematologic response was obtained from the single application to the nasal mucosa of 200 and 150 micrograms of crystalline vitamin B_{12} in 2 patients with pernicious anemia. Thirty-two cases of pernicious anemia in relapse and 55 in remission were controlled satisfactorily by intranasal ad ministration of B_{12} either as saline solution, lactose powder, or crystals. Absorption of the vitamin was probably direct and did not require binding with "intrinsic substance." Chronic disease of the nose did not contraindicate this method of therapy. Local irritation of the mucous membranes by the crystalline B_{12} or the vehicles employed was not observed. (From authors' summary and conclusions)

SARCOMA OF THE STOMACH. ANALYSIS OF 17 CASES.

Ochsner, S., and Ochsner, A. *Ann. Surg.* **142:** 804 (Nov.) 1955.

Of 298 gastric malignancies, 17, or 5.7 per cent, were sarcomas. Most gastric sarcomas are of two types—lymphoma and leiomyosarcoma. Clinical manifestations are nonspecific.

The appearance of any gastro-intestinal symptoms in a previously well adult may indicate that serious disease is present. Radiologic examination is the simplest and most accurate method of diagnosis. Careful mucosal study with fluoroscopy and compression spot-film radiography are essential features of the examination. Lymphomas show a wide variety of radiologic patterns, including lesions resembling fungating and infiltrating carcinomas, benign or malignant gastric ulceration, giant mucosal hypertrophy, and obstruction of the gastric outlet. Leiomyosarcomas have a more characteristic roentgenologic appearance, at least in earlier phases when there is usually a smooth filling defect, often with a central crater. Gastro-intestinal bleeding is commonly associated. For all types of gastric sarcoma, surgical excision is the treatment of choice. In the absence of certain distant metastases, every gastric tumor deserves at least exploration and biopsy. Leiomyosarcomas require bold surgical excision, even massive ones. It is our opinion that lymphomas should receive postoperative radiation, since they are in general very radiosensitive. Roentgen therapy in smaller lesions may control metastatic foci not apparent at operation and, in the non-resectable lesions, may produce prolonged benefit in relieving symptoms and increasing survival. (From authors' summary)

TOTAL RIGHT HEPATIC LOBECTOMY FOR CANCER OF THE GALLBLADDER. REPORT OF THREE CASES.

Pack, G. T.; Miller, T. R., and Brasfield, R. D. *Ann. Surg.* **142:** 6 (July) 1955.

The lack of progress during the last thirty years in the treatment of cancer of the gallbladder is cited. The prospect for cure is no greater than 2 or 3 per cent. This low rate of salvage is the consequence of the fortuitous circumstances in which the cancer occurs, rather than result of a planned adequate operation. Because of the almost universal failures in treatment, including cholecystectomy, total right hepatic lobectomy is suggested as the primary initial treatment for carcinoma of the gallbladder. Data from various sources indicate that carcinoma is found in 1 to 3 per cent of gallbladders removed at operation, usually in coexistence with gallstones. The authors believe that cholecystectomy should always be performed for symptomatic cholelithiasis. If unsuspected carcinoma is found during cholecystectomy, a total right hepatic lobectomy should be performed at that time. The symptom complex of cholecystic carcinoma does not allow early diagnosis. Advanced cancers do not lend themselves to cholecystectomy but may be operable through the use of total right hepatic lobectomy. Three sets of circumstances may indicate the presence of carcinoma of the gallbladder: 1) acute change in symptoms with progressive jaundice, dyspepsia, flatulence, vomiting, and constant pain after tolerating cholecystitis or cholelithiasis for years; 2) insidious asthenia and anorexia with weight loss, vague abdominal discomfort, perhaps slight icterus, and gradual enlargement of the liver; and 3) painless, progressive intense jaundice. The ease with which a gallbladder cancer can metastasize and the lack of cure after seemingly adequate removal by cholecystectomy justify the use of right total hepatic lobectomy. The operative technic is described. In planning the operation, the manner of spread of the cancer must be considered—within the liver by the same mechanism as in the case of malignant hepatoma, and extra-hepatically to lymph nodes in the porta hepatis, hepatoduodenal ligament and retroduodenal region. The fear of hemorrhage is overcome by preliminary ligation of the right branches of the hepatic bile duct, hepatic artery and portal vein within the porta hepatis. A right thoracoabdominal incision makes the operation easier and safer to perform. Immediately postoperatively, the patient must be fortified with protein feedings supplemented by intravenous serum albumin in order to promote liver regeneration. Three cases are reported. Two of the patients had undergone previous surgical treatment for carcinoma of the gallbladder. Two had extensive metastases. The longest period of survival after right toal hepatic lobectomy thus far is two years.

PROLAPSE OF THE VAGINAL VAULT FOLLOWING HYSTERECTOMY.

Ring, H. H. *South M. J.* **48:** 679 (July) 1955.

Prolapse of the vaginal vault following hysterectomy is not a common complication but may become more so as this procedure is performed more frequently. The prolapsed vaginal vault presents below the introitus and contains the urinary bladder, the rectum, and sometimes coils of the intestine. The cause is unknown, but it may be related to an abnormally weak pelvic structure with a tendency toward relaxation of the pelvic floor. Four cases of prolapse of the vaginal vault and 2 of complete uterine prolapse are presented. Except in 1 instance, the patients were overweight. It appears that in obese women there may be relaxation of the pelvic structures following child bearing. All of the patients were elderly and the prolapse occurred when other changes of advancing age were manifest—in some, many years after hysterectomy. Hysterectomy may not have been indicated in 4 of the patients; repair of the lacerated or relaxed pelvic floor might have been sufficient. The cases of complete uterine prolapse could have been managed by removal with closure of the vagina when the uterus was removed. A vaginal operation to correct prolapse of the vaginal vault is described. It can be used in elderly women who do not require a functioning vaginal tract, and prophylactically at the time of hysterectomy.

PRIMARY SARCOMA OF THE LIVER: A REPORT OF THREE CASES.

Simpson, H. M., Jr.; Baggenstoss, A. H., and Stauffer, M. H. *South. M. J.* **48:** 1177 (Nov.) 1955.

Primary sarcoma of the liver is a rare lesion; fewer than 100 cases have been reported. Data are presented from 3 cases found in a review of primary malignant neoplasms of the liver observed at necropsy at the Mayo Clinic between 1914 and 1953. The study included 45 cases of primary carcinoma of the liver. The sarcomas differed in their gross and histologic appearance, as have previously reported sarcomas of the liver. This is a disease of the very young and of the elderly. The tumors in the elderly may exhibit a higher degree of malignancy, *i.e.*, more rapid proliferation, more frequent appearance of mitotic figures, and a greater tendency to local spread and distant metastasis. The sex ratio seems to be 2 males to 1 female. In adults, cirrhosis is a frequently associated condition. The tumors occur in three principal forms: *massive*, occupying an entire lobe; *nodular*, which is the most frequently reported type; and *diffuse*, with infiltration of sarcomatous tissue throughout the liver. Histologically, primary sarcoma has been classified as angiosarcoma, alveolar sarcoma, spindle-cell sarcoma, and round-cell sarcoma. The majority of cases of primary sarcoma of the liver are vascular in origin. Metastasis occurs by direct extension, implantation, and vascular and lymphatic channels. The symptoms in adults are ill defined but may include weakness, anemia, anorexia, dyspepsia, an enlarging abdominal mass, and pain in the right upper quadrant with extension to the right posterior chest and shoulder. Jaundice caused by extrahepatic bile-duct obstruction may be present. Laboratory findings have been too incomplete to be significant and would probably be nonspecific. Only supportive treatment was used in the 3 cases reported.

CLINICAL EXPERIENCE WITH A NEW COMBINATION OF HYPOTENSIVE AGENTS.

Smith, C. W.; Quickel, K. E.; Brown, A. E., and Thomas, C. G. *Am. J. M. Sc.* **230:** 415 (Oct.) 1955.

Sixty-five patients with hypertension classified as mild in 14, moderate in 35, and severe in 16 were treated with MioPressin. Twenty-six of the patients were beyond the age of 60 years. Evidence of renal damage was present in 31. The hypertension was graded in accordance with the diastolic pressure, as follows: mild, 110 mm. or less; moderate, 111 to 130 mm.; and severe, 131 mm. or higher. MioPressin is a hypotensive preparation that contains

in each capsule 25 mg. of *Rauwolfia serpentina*, 0.2 mg. of protoveratrine, and 5 mg. of phenoxybenzamine. The most frequent dosages used were four and six capsules daily. The action and shortcomings of each of the components are discussed. The combination was proposed to provide a multiple attack on mechanisms maintaining hypertension by acting simultaneously through the hypothalamic sympathetic centers and the vagal reflexes, and by producing peripheral adrenergic blockade. Treatment with MioPressin was continued for one to three months in 12 patients, for four to seven months in 17 patients, and eight months or more in 36 patients. The response was classified as good when a drop occurred in the diastolic pressure of 15 mm. or more to a final value of 100 mm. or less; as fair with a drop of 15 mm. or more but not to 100 mm. or less, or a drop of 10 to 15 mm. to 100 mm. or less; and as poor for all other responses. The results were as follows: a good response in 37 patients (57 per cent), fair in 14 (21.5 per cent), and poor in 14 (21.5 per cent). Sixty-three per cent of the patients became normotensive by the conclusion of the study. The percentages of patients in the various groups who became normotensive were: mild, 79; moderate, 66; and severe, 44. A significant decrease occurred in the blood urea nitrogen level after six months of therapy. The side-effects were usually mild, and necessitated discontinuation of therapy in only 7 patients. The most frequent side-effects were nasal stuffiness and fatigue, which usually could be controlled by the use of antihistamines for the former and *d*-amphetamine sulfate for the latter. The combination of agents in MioPressin is concluded to be the hypotensive preparation of choice whenever hypertension may be inferred to be the result of complex or obscure processes rather than a specific etiologic factor.

A BIOCHEMICAL TEST FOR CHORIONIC GONADOTROPHIN IN THE URINE AND ITS VALUE AS AN AID IN THE DIAGNOSIS OF PREGNANCY AND MALIGNANCY.

Terrell, T. C., and Beard, H. H. *South. M. J.* **48:** 1352 (Dec.) 1955.

The technic for a quantitative biochemical test for the determination of chorionic gonadotrophin in urine is described. Two important points in the technic of the test for malignancy are that the urine is concentrated by acetone precipitation, and that chorionic gonadotrophin alone is digested out by chymotrypsin. The test is presented as valuable in the diagnosis of pregnancy and malignancy, in both of which the excretion of chorionic gonadotrophin is increased. Values above 30 mg. per twenty-four hours were considered to be indicative of pregnancy or malignancy, inasmuch as the values in normal individuals were below this level. The results of this test and of total estrogen determinations in 78 normal young pregnant women agreed with those of other investigators in human pregnancy. When the test was used in screening 35 urines from individuals with various clinical conditions, it was found that false positive results were obtained in the urine from patients with the following: pregnancy, postpartum states, hydatiform mole, diseases of the liver, and conditions in which an excess of chorionic gonadotrophin was excreted. Among 51 cases of proven malignancy, the test showed an elevated chorionic gonadotrophin excretion in 94 per cent. Total estrogens were high in 90 per cent. A positive assay for one or the other was obtained in all 51. Among 29 patients used for prognostic purposes, the prognosis was good (probable absence of metastasis) in 8 patients with no chorionic gonadotrophin in the urine after operation. The test indicated the presence of metastasis in 11 patients. In 9, the titers of both chorionic gonadotrophin and total estrogen increased as the disease progressed to death. The diagnostic and prognostic possibilities of the test are discussed.

WEBER-CHRISTIAN DISEASE.

Wasserman, E. *Am. Pract. & Digest Treat.* **6:** 1169 (Aug.) 1955.

Weber-Christian disease is described in a 70-year-old woman who is perhaps the oldest person ever reported to have this condition. The etiology of this syndrome remains in doubt. At the onset of the illness, a peripheral vascular problem presented itself. A diagnosis of

thrombophlebitis was made and ligation of the right superficial femoral vein performed. Tender subcutaneous nodules appeared on the thigh, abdomen, and back thereafter. The patient had no history of halogen ingestion nor evidence of focal infection. Slight leukocytosis was noted. Improvement with amelioration of symptoms occurred following the administration of cortisone. Daily maintenance dosages of 125 to 150 mg. were continued for two years. Immediate reappearance of nodules and a febrile reaction followed attempts to lower the dosage. Complications of this therapy were osteoporosis of the spine, edema, increased fat deposition, and the development of hypertension and congestive failure. After two years of treatment, the patient complained of severe generalized abdominal pain, but roentgenographic examinations of the gastro-intestinal tract showed nothing abnormal. The patient grew weaker, the peripheral edema increased, and pulmonary rales appeared. Cortisone was gradually withdrawn and ACTH administered in an attempt to stimulate the adrenal glands. However, the downhill course continued and the patient expired. At the height of the disease, there was a 4-plus reaction to the Kahn test. This change in a patient in whom previous serologic test results had been negative and in whom there was no history of syphilis, together with reversal of the albumin-globulin ratio as found in collagen disease, lends support to the theory of a relationship between Weber-Christian disease and collagen diseases.

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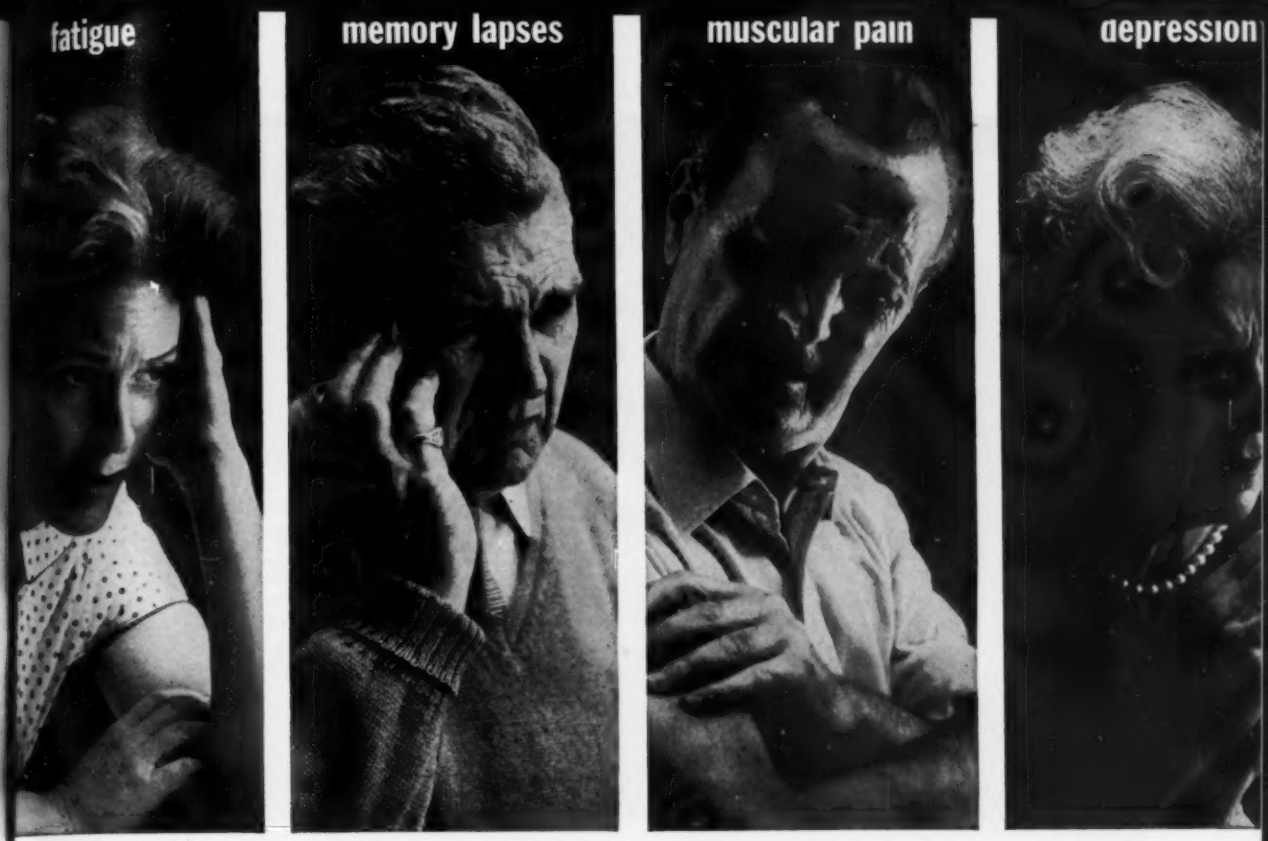

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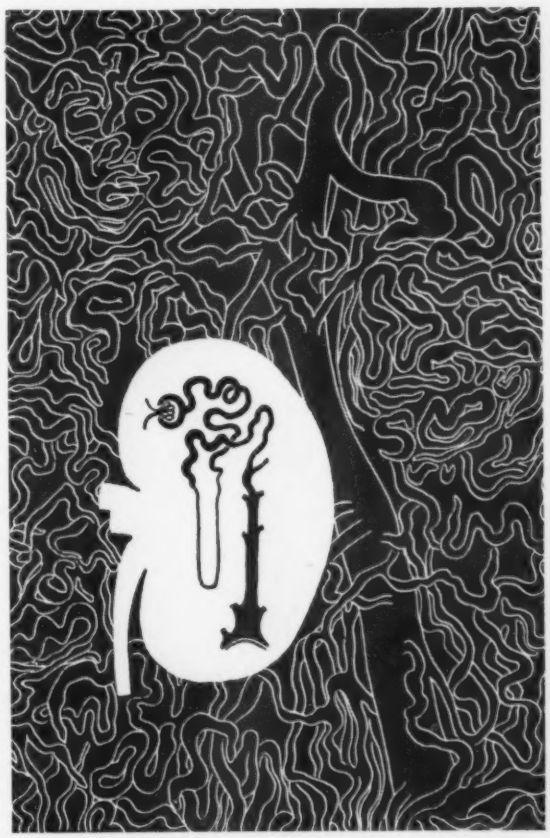

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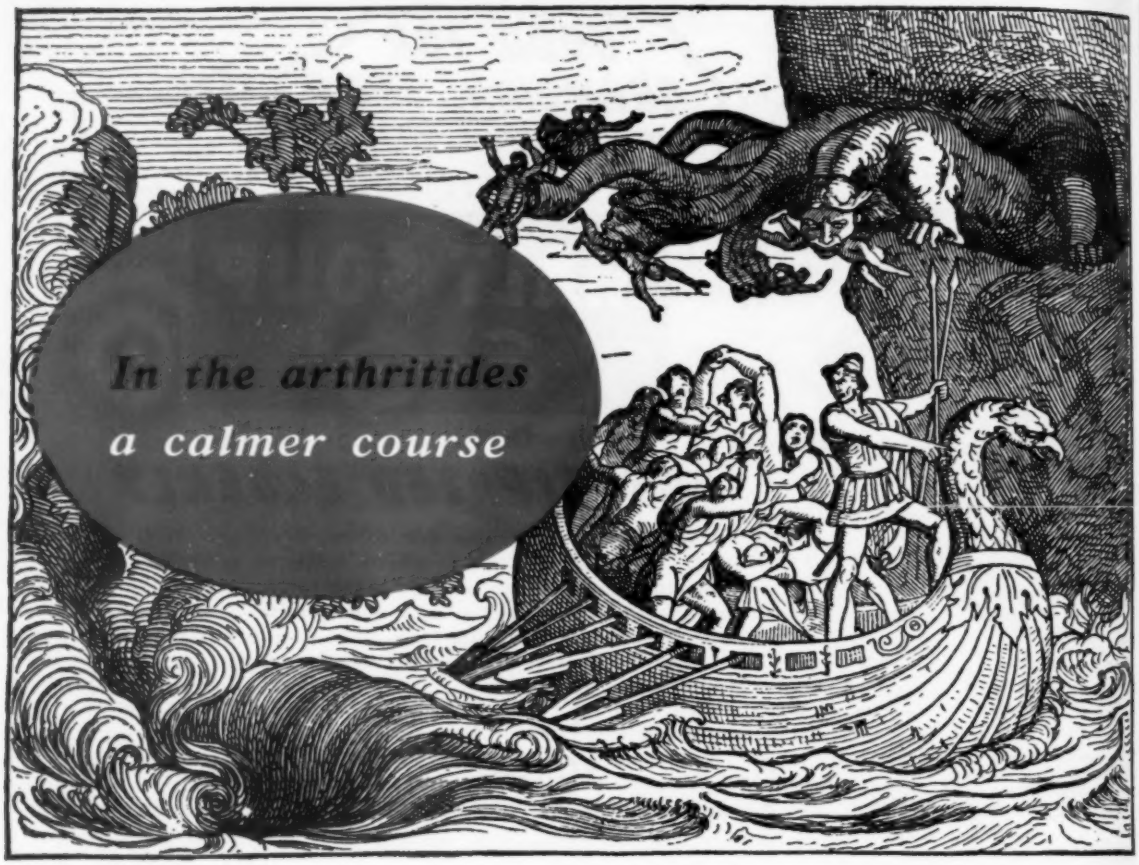

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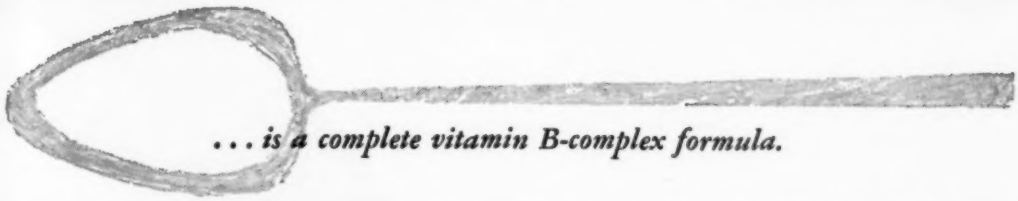

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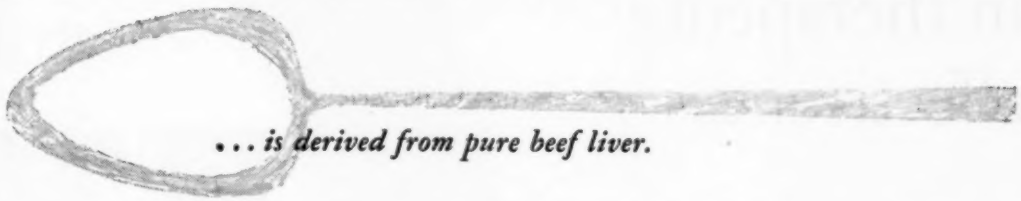

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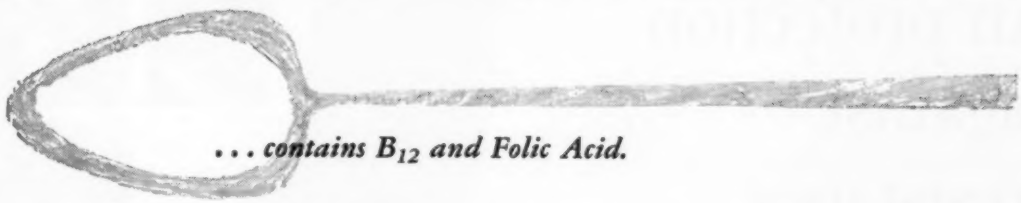

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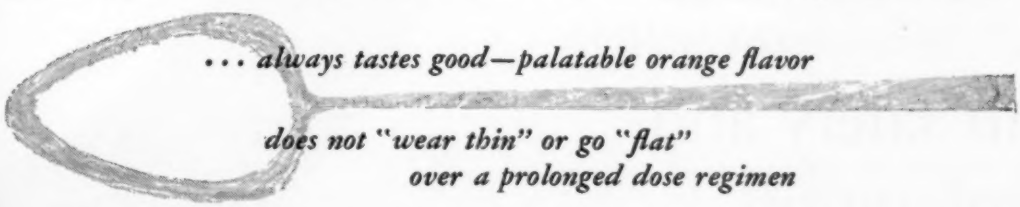

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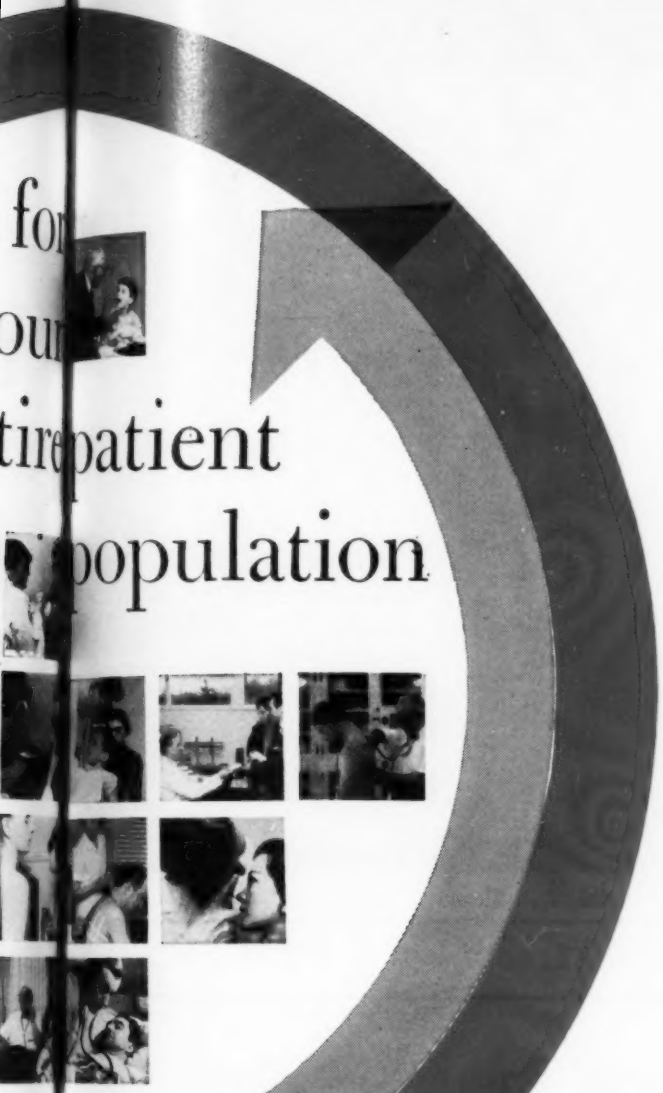

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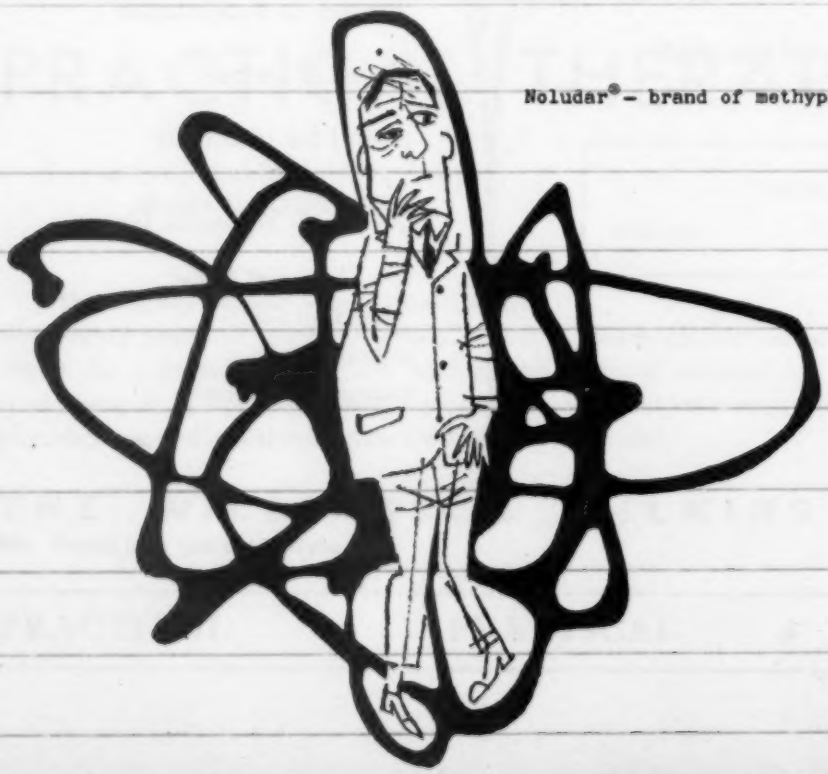

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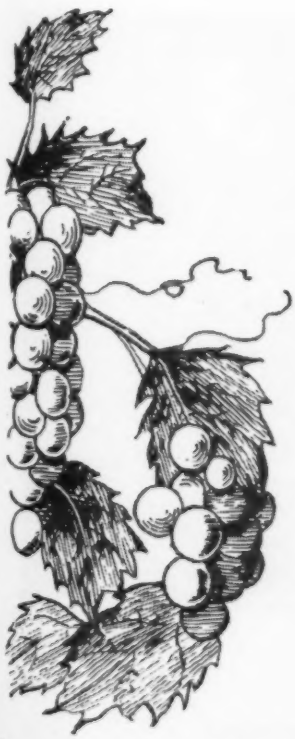

- wine stimulates olfactory acuity—markedly increasing appetite in anorexia
- wine serves as a quick-energy food. Its small amount of hexose is speedily absorbed and its moderate content of alcohol is metabolized readily even by diabetics
- wine possesses significant vasodilating, diuretic and relaxing properties of value in the field of cardiology
- a little Port or Sherry at bedtime is a valuable relaxant to the insomniac and may obviate the need for sedative medication

And wine can help brighten the often unappealing character of special or restricted dietaries—a psychological boost of inestimable value to the debilitated and depressed patient.

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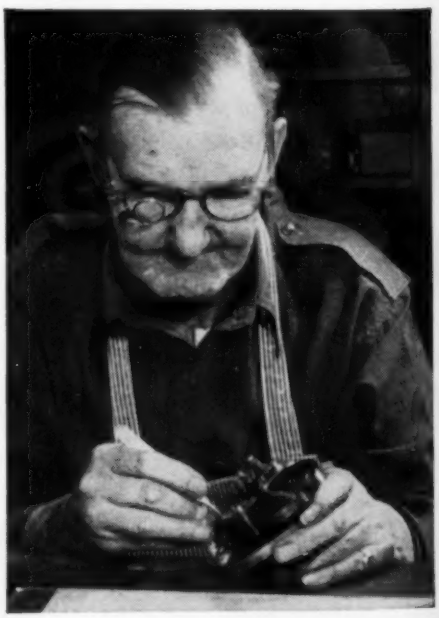

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1. Katz, E.M., and Kowaliczko, Z.: Internat. Rec. Med. *169*:596 (Sept.) 1956. 2. Barrabee, P.; Wingate, J. H.; Phillips, B. D., and Greenblatt, M.: Postgrad. Med. *19*:485 (May) 1956.

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"In the lay mind, anyone past 60 is ready for the discard . . ."[2]

". . . there are only three principal phases in the span of life: infancy, adolescence and senescence."[3]

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To the physician on the firing line of daily practice, the question of "how old is old?" seems academic. To him, a more valid question is "How can I allay the effects of the aging process?"

FIVE PROBLEMS IN AGING

The answer, according to most authorities, is manifold, for five treatable problems seem to predominate. One, obviously, is gonadal hormone decline. Another is mild anemia. A third is the decreased production of gastric and digestive enzymes. Mineral-vitamin deficiency is the fourth. And the fifth – perhaps most important – is inadequate high-quality protein intake.

THERAPY FOR AGING

Judging from this confused clinical picture of aging, therapy for the problem would appear difficult. However, most physicians agree that a product which could correct most or all of these five commonest problems would remove past obstacles to satisfactory response. Such a product would, essentially, be true "preventive geriatrics."

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Non-stimulatory gonadal hormone replacement

balanced hematinic component

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new lysine, for protein improvement*

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* Protein deficiency among the aging apparently stems from their excessive intake of white-flour foods which furnish incomplete protein of low biologic value. White bread protein, for example, has been shown by nutrition studies in animals[5] to be deficient only in the amino acid, lysine. In human subjects metabolic determinations indicate that the addition of supplemental lysine to a basal white-flour protein diet can convert a negative nitrogen balance into a positive one.[6]

A WORD ABOUT SYMPTOMATOLOGY

In spite of jokes to the contrary, the patient who states in the professional office that "old age is creeping up" is a rare bird indeed.

Seldom is old age the presenting complaint. Thus the physician, after correcting the specific complaints, must re-evaluate the whole person to judge his candidacy for "preventive geriatrics." Such people have much to gain from NEOBON therapy. The rewards are fuller, more active, more pleasurable years for patients past 40. The daily dose (3 capsules) of NEOBON provides:

L-lysine	150 mg.
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Riboflavin (Vitamin B_2)	1.5 mg.
Pyridoxine Hydrochloride (Vitamin B_6)	1.5 mg.
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Cobalt (from Cobaltous Sulfate)	0.1 mg.
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**Enzymatically active defatted material obtained from 1,500 mg. whole fresh liver and stomach.

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Supplied: Bottles of 60 capsules, prescription only.

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A GERIATRIC TONIC

Now also available for your consideration is NEOBON LIQUID, which provides hematinic action, improved carbohydrate and protein utilization, gonadal and thyroid hormone supplementation and a mild antidepressant action.

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Folic Acid	167 mcg.
Vitamin B_{12}	2.5 mcg.
l-Thyroxine	0.1 mg.
Ethinyl Estradiol	1 mcg.
Methyltestosterone	1 mg.
Liver Fraction I	25 mg.
Ethyl Alcohol	0.5 cc.

Dosage: One teaspoonful twice daily before meals, or as required.

Supplied: In 16 fluid ounce bottles, prescription only.

Bibliography

1. Anonymous. 2. Rosenthal, P.: Geriatrics 10:382 (August) 1955. 3. Lansing, A. I.: Symposium on Problems of Gerontology, National Symposium Series No. 9 (August) 1954. 4. Mason-Hohl, E.: Quoted in W. Va. Med. J. 51:16 (January) 1955. 5. Rosenberg, H. R., et al.: Arch. Biochem. and Biophys. 49:263, 1954. 6. Bricker, M., Mitchell, H. H. and Kinsman, G. M.: J. Nutrition 30:269, 1945. 7. Masters, W. H. and Bailew, J. W.: Geriatrics 10:1, 1 (January) 1955.

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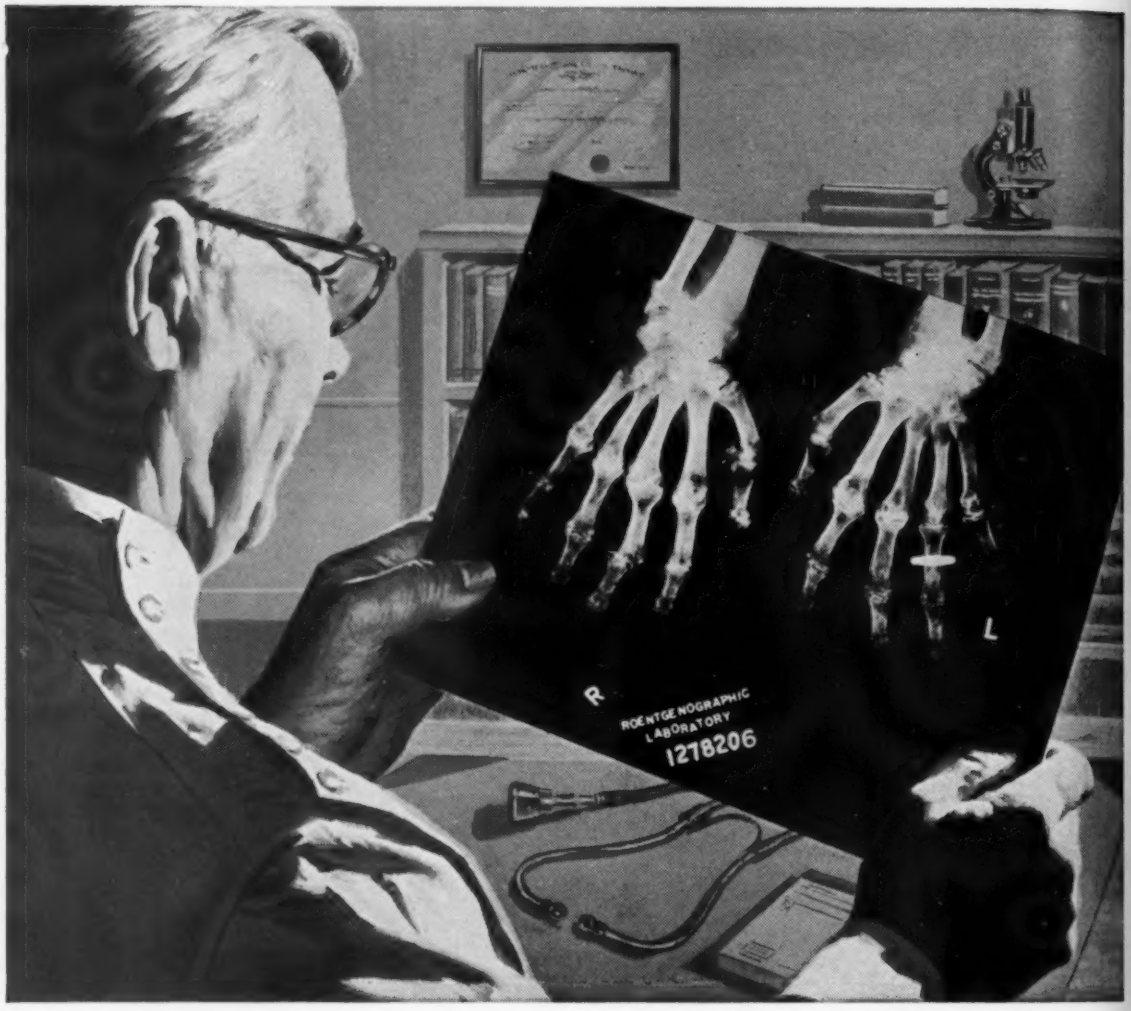

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REFERENCES:
1. J.A.M.A. 159:645 (Oct. 15) 1955.
2. J.A.M.A. 158:386 (June 4) 1955.

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References

1. Store, F. J.: *Bull. New York Acad. Med.* **32**:284, 1956
2. Kaufman, W.: *J. Am. Geriatrics Soc.* **3**:927, 1955
3. Kinsell, L. W.: *J. Am. Geriatrics Soc.* **3**:31, 1955
4. Kaplan, L.; Landes, J. H. & Pincus, J.: *Geriatrics* **10**:287, 1955

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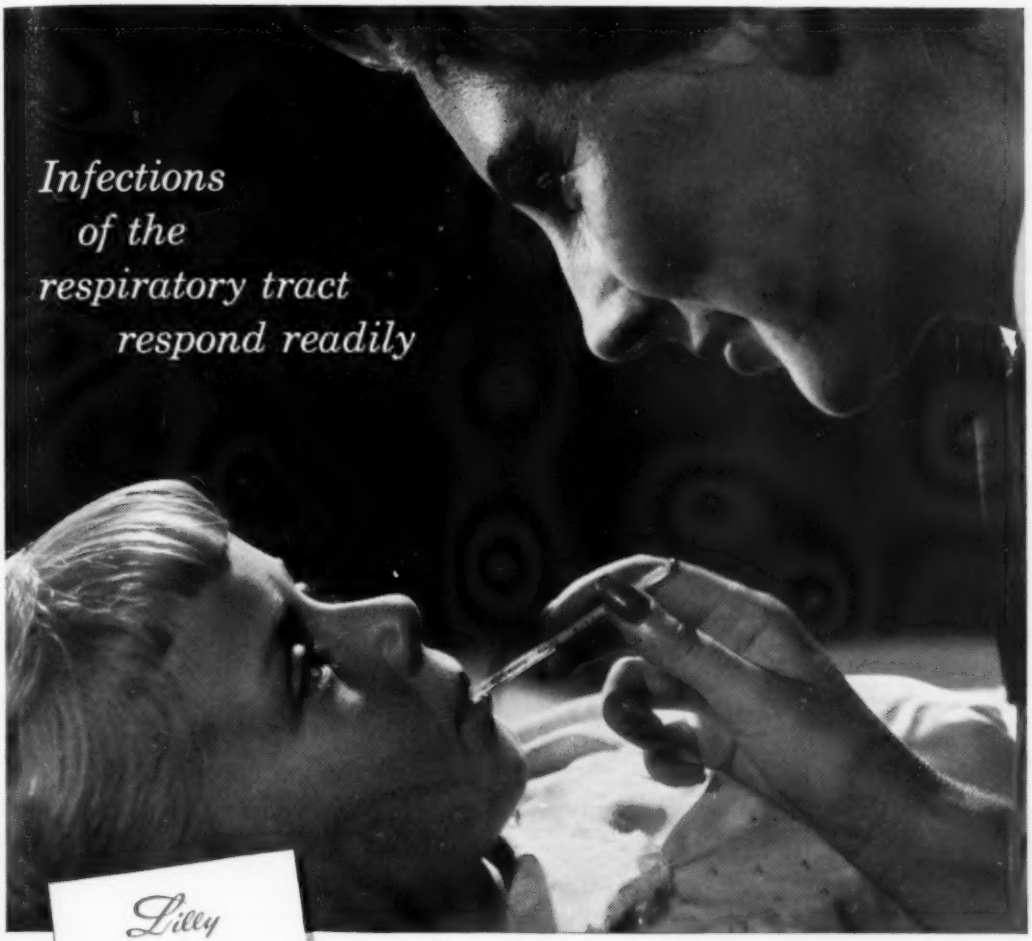

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Pyridoxine HCl (B_6)	0.5 mg.	Copper (as CuO)	1 mg.
Ca Pantothenate	5 mg.	Fluorine (as CaF_2)	0.1 mg.
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Inositol	50 mg.	Magnesium (as MgO)	1 mg.
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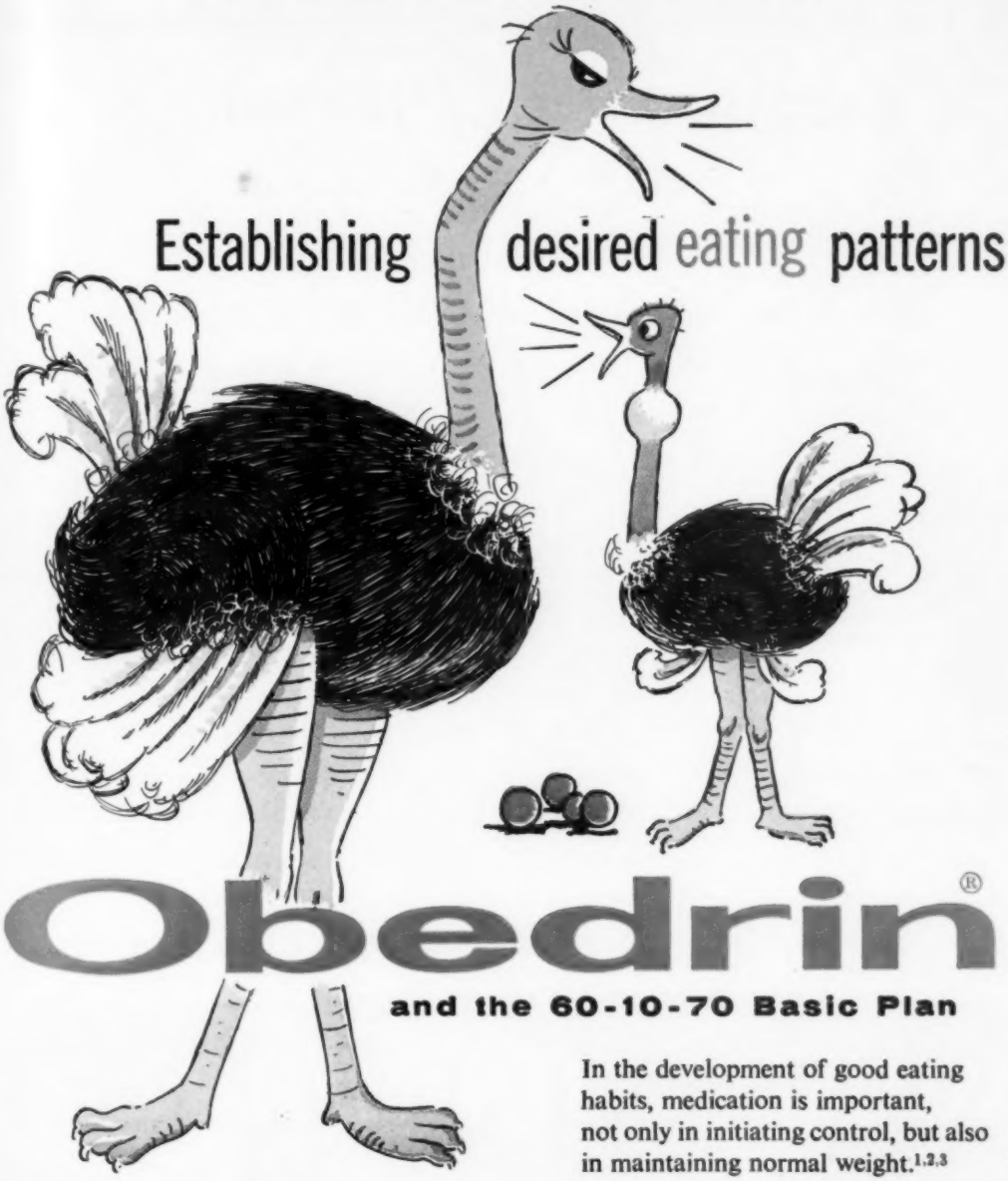

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1. Eisfelder, H.W.: Am. Pract. & Dig. Treat., 5:778 (Oct.) 1954).
2. Sebrell, W.H., Jr.: J.A.M.A., 152:42 (May, 1953).
3. Sherman, R.J.: Medical Times, 82:107 (Feb., 1954).

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References: **1.** Rosenberg, H. N., and Michelson, A. L.: Am. J. M. Sc. *230*:254 (Sept.) 1955. **2.** Kory, R. C., *et al.*: Am. Heart J. *50*:308 (Aug.) 1955. **3.** Winsor, T., and Humphreys, P.: Angiology *3*:1 (Feb.) 1953. **4.** Plotz, M.: New York State J. Med. *52*:2012 (Aug. 15) 1952. **5.** Dailheu-Geoffroy, P.: L'Ouest-Médical, vol. 3 (July) 1950.

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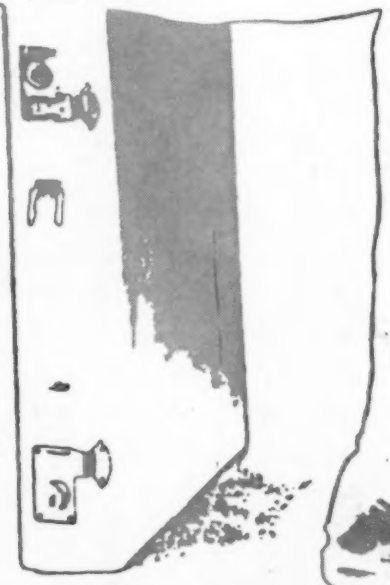

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